AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

APRIL 1947

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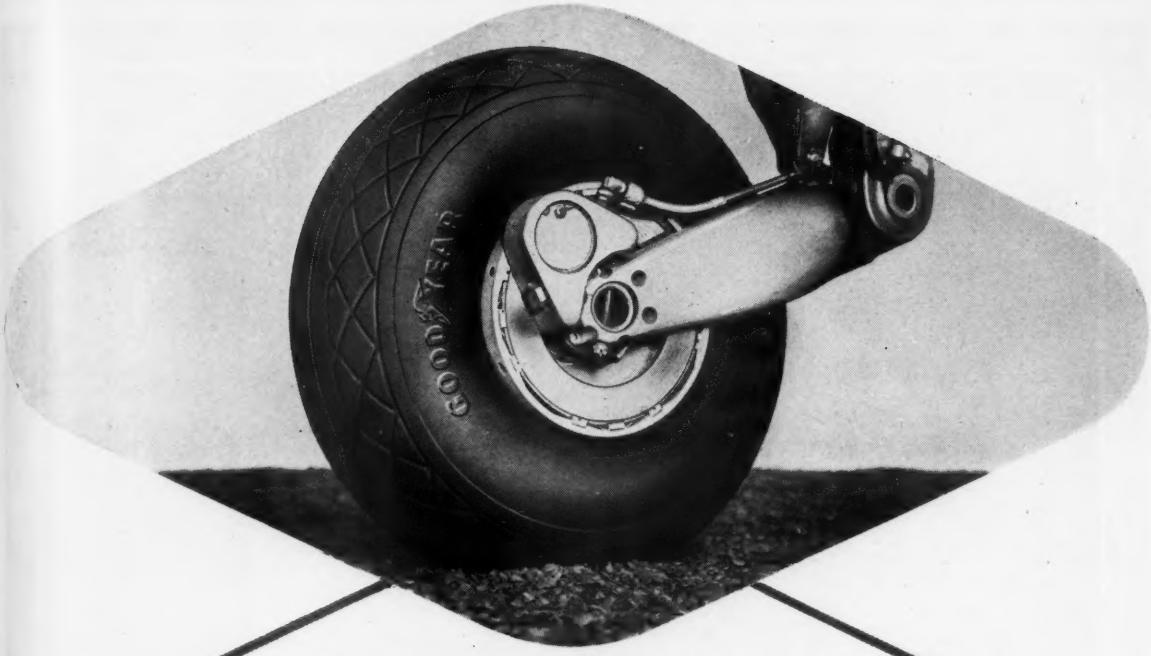

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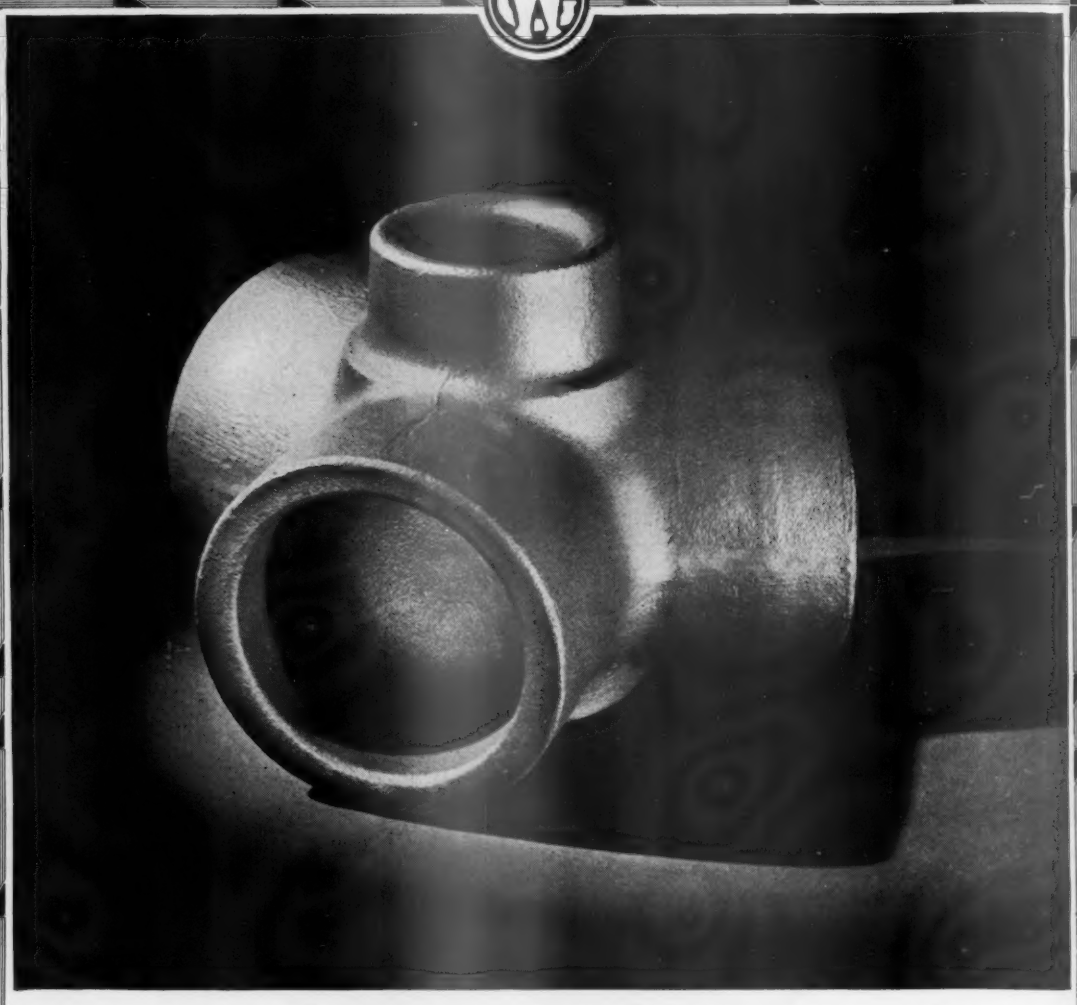

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Official U.S. Navy Photograph

Cover—The Navy's newest jet fighter, the F6U Pirate, undergoes extensive test program at Muroc Dry Lake, Calif. Ship was built by Chance Vought Aircraft Division, United Aircraft Corporation.

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AERONAUTICAL ENGINEERING REVIEW

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Published Monthly by the Institute of the Aeronautical Sciences, Inc.

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

I.A.S. News

A Record of People and Events of Interest to Institute Members

"What the Customer Wants," Topic of Personal Aircraft Meeting

Plans Set for Technical Sessions, Luncheons, and Dinner in Detroit, May 26–27. Walter C. Jamouneau chosen as Committee Chairman.

THIS YEAR'S National Personal Aircraft Meeting in Detroit, May 26–27, will bring engineers, designers, and the private pilot together for the fourth consecutive year to discuss the good and the bad points of the present-day personal plane. Future modifications and designs will be considered by representatives of every phase of interest in private flying in two afternoon and two evening technical sessions. All events will take place in the Rackham Educational Memorial of the Engineering Society of Detroit.

With the increase in private-flier population, the number of problems to be solved also increases. The importance and timeliness of the meeting is expected to attract a larger attendance than ever before.

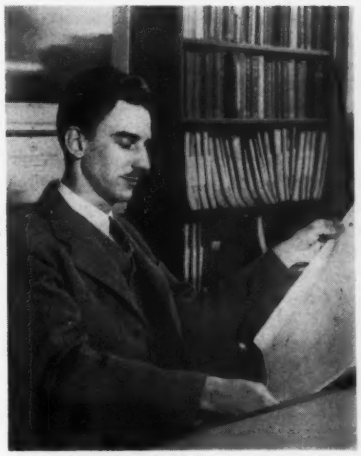
The evening Symposium, "What the Customer Wants," May 26, will offer a particularly well-rounded survey of personal plane problems and requirements. Chairman Ralph H. Upson, University of Minnesota, will open this general topic to be discussed by six pilots and engineers. The Symposium will be sponsored jointly by the Engineering Society of Detroit and the I.A.S. with assistance from the Aircraft Owners and Pilots Association.

A luncheon will precede each afternoon session, and on the last evening a dinner, given by the Institute and the Engineering Society of Detroit, will precede the Symposium. W. T. Piper, President of Piper Aircraft Corporation, will be guest speaker, and L. W. Pogue, Aeronautical Consultant, will act as Toastmaster at the dinner.

The following papers have been scheduled at this time: "The Design Engineer's Role in Airplane Cost Reduction," by Horrell G. Erickson, Structural Design Engineer, Luscombe Airplane Corporation; "A Review of Service Experience with Aircraft Power-Plant Installations," by David L. Posner, Chief, Installation Section, C.A.A.; "Installation Problems with Submerged Engines," by W. F. Burrows, Chief Project Engineer, and Reginald I. Rice, Installation Engineer, Aircooled Motors, Inc.; "United Design for Performance and Safety Characteristics," by Frederick W. Ross, University of Michigan; "Ejector Cooling and Muffling," by Otto Koppen, Massachusetts Institute of Technology; "The Roadable Airplane," by Joseph Gwinn, Chief Engineer, Hoist and Body Division, Gar Wood Industries, Inc.; "Design of Automotive Mufflers," by a G.M. engineer; paper on the Skysedan by Piper Aircraft.

Walter C. Jamouneau, Piper Aircraft Corporation, is serving as Chairman of the Personal Aircraft Meeting Committee. Others on the committee are as follows: Peter Altman, Aeronautical Consultant; A. Francis Arcier, The Waco Aircraft Company; W. E. Burnham, Beech Aircraft Corporation; Carl T. Doman, Aircooled Motors, Inc.; J. P. D. Garges, Fairchild Personal Plane Division; Raymond Hermes, Aeronca Aircraft Corporation; Robert Insley, Continental Motors Corporation; Franklin T. Kurt, Grumman Aircraft Engineering Corporation; E. W. Norris, Luscombe Airplane Corporation; Kenneth E. Smith, University of Detroit; Ralph H. Upson, University of Minnesota; and Fred E. Weick, Engineering and Research Corporation.

Michigan's 8-day Aviation Show, backed by the Aero Club of Michigan, should lend a fitting atmosphere for the 2-day Institute conference.



Walter C. Jamouneau.

I.A.S. Calendar

May 26–27, 1947	Personal Aircraft Meeting,	Detroit, Mich.
August 7–8, 1947	Annual Summer Meeting,	Los Angeles, Calif.

For further details see page 19.

Fairchild Forms Association of Technical Consultants

Sherman M. Fairchild has formed a new organization that will specialize in business analyses and forecasts with emphasis on technical development. Mr. Fairchild, whose career in the field of aviation and related industries extends over a period of 28 years, is one of the founders and long-time supporters of the Institute. He is at present a member of the Council.

The new organization, located at 30 Rockefeller Plaza, will be known as Sherman Fairchild and Associates. Mr. Fairchild will continue his active work in the Fairchild Camera & Instrument Corporation as Board Chairman and in the Fairchild Aerial Surveys, Inc. He recently resigned his connections with Fairchild Engine and Airplane Corporation as a Director and Board Chairman.

Sherman Fairchild and Associates will be available as consultants and representatives to individuals or corporations interested in evaluation of businesses. It will conduct research studies and market analyses as well as advise in problems of production and production costs.

As an inventor and business executive, Mr. Fairchild has been responsible for the organization of many famous companies which bear his name. Fairchild airplanes and Fairchild aerial cameras are known and used throughout the world. He has contributed to the technical development of aircraft power plants and many familiar products and processes that have assisted the advance of the science of aeronautics.

Mr. Fairchild is a Director of Pan American World Airways System, International Business Machines Corporation, and G. M. Giannini & Company, Inc.

Sherman M. Fairchild.

Juan T. Trippe receiving award from President Truman.

Juan T. Trippe Awarded Trophy by President Truman

President Truman presented the Harmon Aviation Trophy to Juan T. Trippe, President of Pan American World Airways System and an Associate Member of the Institute, at the White House recently. The ceremony was attended by high officials of the Army, Navy, and government agencies.

The Ligue Internationale des Aviateurs made the award to Mr. Trippe as directing head of Pan American World Airways for "outstanding leadership, patriotism, unselfish devotion to the security and economic progress of the United States" in the critical days preceding and during World War II.

It is the custom for the President of the United States annually to present the Harmon Trophy to the year's outstanding figure in aviation, but because no award had been made since the war, the trophy for Mr. Trippe will cover the period from 1940 to 1946.

Davidson Awarded Wetherill Medal by Stevens Institute

Dr. Kenneth S. M. Davidson, an Associate Fellow of the Institute and Director of the Experimental Towing Tank Laboratory, The Stevens Institute of Technology, received the John Price Wetherill medal at The Franklin Institute's annual Medal Day ceremonies, April 16, at Philadelphia. The award was made for his "contribution to the improved design of ships through his experimental work on ship-model hulls."

Dr. Davidson has been associated with Stevens Institute since 1930 and has been Director of the Experimental Towing Tank since 1935. In that year a small towing tank, 100 ft. long, was constructed. Under his leadership, in the years that followed, the project grew to include three of the most modern towing tanks in the country and a staff of 60 persons carrying on long-range hydrodynamic research and model tests of Army, Navy, and civil ships and aircraft hulls.

Dr. Davidson's work in hydrodynamics has been instrumental in establishing small towing tanks and models as recognized research instruments capable of predicting accurately the performance of larger vessels. His investigations of such little understood phenomena as "porpoising" of seaplanes and the behavior of ships in turning and steering have made him internationally famous in the field of model testing.

Barnaby Joins Staff of The Franklin Institute

Captain Ralph S. Barnaby, well known in aviation circles as a pioneer in motorless flight, has joined the staff of The Franklin Institute. He is in charge of investigating and designing pilotless aircraft and of other aeronautical research development.

Captain Barnaby, born in Meadville, Pa., January 21, 1893, was graduated from Columbia University in

1915. He served with the Navy for 29 years. His work with the Navy was largely devoted to the study, design, and construction of aircraft, and in 1930 he achieved international notice by being launched in a glider from the Navy rigid airship, the U.S.S. "Los Angeles."

Considered an authority on gliding, soaring, and towed flight, he was one of the founders of The Soaring Society of America and is currently serving a fourth term as President of that organization. Captain Barnaby is a Fellow of the Institute.

Bell Awarded Chancellor's Medal by University of Buffalo

Lawrence D. Bell, President and founder of the Bell Aircraft Corporation, has received the University of Buffalo's highest award, the Chancellor's Medal. Mr. Bell's "dynamic and creative leadership" in the field of aviation won him the distinction of being the first industrialist to receive this award. The citation states that this honor ". . . . is awarded by the Chancellor of the University of Buffalo for outstanding accomplishment. . . . which in itself is truly ennobling and which dignifies the performer and Buffalo in the eyes of the world."

Mr. Bell's intense interest in aviation led him at the age of 17 into The Glenn L. Martin Company, where a year later he became shop foreman. He was Vice-President and General Manager of the company from 1913 to 1925. He was later affiliated with the Consolidated Aircraft Corporation and served as General Manager from 1928 to 1935. Mr. Bell then organized his own company, specializing in the design and production of fighter airplanes. In recent years the company has also specialized in the helicopter field.

Lawrence D. Bell.

Capt. Ralph S. Barnaby.

In 1944 Mr. Bell was awarded The Daniel Guggenheim Medal "for achievement in design and construction of military aircraft and for outstanding contributions to the methods of production." He is an Associate Member of the Institute.

M.I.T. Special Summer Session

Professor Eric Reissner, Associate Professor of Mathematics and an Associate Fellow of the Institute, announces that the Massachusetts Institute of Technology will hold a special Summer Session in Applied Mathematics from August 4 to September 19, 1947.

The following graduate courses will be offered: (1) Theory of Plates and Shells, by Profs. F. B. Hildebrand and E. Reissner. (2) Theoretical Hydromechanics, by Profs. E. Reissner and C. C. Lin. (3) Advanced Topics in Applied Mathematics, by Profs. J. L. Synge, H. Reissner, W. Prager, F. B. Hildebrand, and P. D. Crout. (4) Tensors in Mechanics, by Prof. D. J. Struik.

Further information concerning the program may be obtained by writing to the Department of Mathematics, Massachusetts Institute of Technology, Cambridge 39, Mass.

Gifts to the Institute Collections

Complete files of its *Notes Techniques, Bulletins du G.R.A.*, and *Rapports Techniques* were received from the Groupement Français pour le Developpement des Recherches Aéronautiques (G.R.A.) in Paris. Jerome C. Lederer gave 350 *Wartime Reports* of the National Advisory Committee for Aeronautics. Papers on meteorology by Willis Ray Gregg were received through the courtesy of Mrs. Gregg. A complete file of *L'Aerophile* for 1941 was sent by André Charriou of Paris. Sheet music, photographs, and pins were received from Eric Hildes.Heim. Publications of the Service de Documentation et d'Information Technique de l'Aéronautique, Ministère de l'Armement, were received from The Research Corporation through the courtesy of A. S. Davis, Jr.

News of Corporate Members

Breeze Corporations, Inc., of Newark, N.J., has acquired all of the capital stock of Aircraft Standard Parts Company, Inc., of Rockford, Ill., patentee and manufacturer of the Aero-Seal Clamp. The Aero-Seal Clamp, a wartime development, was delivered entirely to the Army and Navy Air Forces. After the war it was offered for automotive and industrial use and is now being used commercially. Breeze Corporations, Inc., plans to increase the production of the Rockford plant. It is reported that shipments have been more than doubled during the past 6 months.

The Chance Vought Aircraft Division of United Aircraft Corporation has instituted a comprehensive training program designed to increase the scope of work knowledge and the experience level of the shop foremen. The first phase of the program provides for periodic transfer of supervisory personnel between the various units of a specific manufacturing group. Frequency of transfers and assignments of personnel will be determined by shop division superintendents. This transfer of assignment is expected to make the foremen familiar with all the different subassemblies and major assemblies of Chance Vought production airplanes.

The General Aviation Equipment Company, Inc., has moved its New York executive and sales offices from 630 Fifth Avenue to the same building in which its engineering laboratories are located, 2 East End Avenue. This transfer was made to coordinate more effectively its activities in the New York region. The company is engaged in research, designing, engineering, and manufacturing for aviation and other industries.

Leonard S. Hobbs, Vice-President for Engineering, United Aircraft Corporation, turns the first spadeful of earth to mark start of construction on Pratt & Whitney Aircraft's new several-million-dollar gas turbine laboratory at East Hartford, Conn., March 5. Looking on, left to right, are: Norman V. Clements, Director of Advertising and Sales Promotion; Capt. John E. Ostrander, Bureau of Aeronautics Representative at Pratt & Whitney Aircraft; William P. Gwinn, General Manager, Pratt & Whitney; Erle Martin, General Manager, Hamilton Standard Propellers; J. D. Ballard, Engineer, Pratt & Whitney; and H. M. Horner, President, United Aircraft Corporation.

The Glenn L. Martin Company has moved into the helicopter field with the purchase of the assets and patents of Rotawings, Inc., Philadelphia. The establishment of a special division for research and experiment with helicopter control systems, rotor hubs, and blades also is planned. The new Martin Rotawings Division will have its headquarters at North Wales, Pa. "Experiments with rotating wing aircraft have been going on several years with varying degrees of success," Mr. Martin stated. "We believe that the Martin company can make its greatest contribution in this phase of aviation by concentrating for the present time on development of more efficient rotor hubs, rotor blades, control systems, and power plant transmission devices."

Northwest Airlines, Inc., will have all-electronic automatic pilots installed on fleets of Boeing Stratocruisers and Martin 3-0-3 transports now being built for the company. The equipment, the PB-10 automatic pilot made by the Eclipse-Pioneer Division of Bendix Aviation Corporation, will cost more than $500,000. It has an overall weight of approximately 200 lbs. and will be functionally associated with the I.L.S. now being installed at major airports.

Pratt & Whitney Aircraft Division of United Aircraft Corporation has begun construction of the first unit of a proposed several-million dollar gas-turbine laboratory in connection with its large program of gas-turbine engine research and development. The new laboratory will be situated on the east bank of the Connecticut River at a point opposite Hartford's Brainard Aviation Field. Giant steam turbines will provide power ranging from 5,000 to 18,000 hp. in single test units. Much of the power equipment for the compressor-test laboratory was obtained from H.M.S. "Bligh," a surplus lend-lease destroyer-escort returned to the U.S. Navy by the British after the war. Equipment from several other surplus war vessels has also been purchased and will be utilized in other units of the gas-turbine laboratory as construction proceeds.

The compressor-test laboratory is an L-shaped structure with overall dimensions of 125 by 75 ft. It will have two major parts—a power-plant area and a test-cell section. Installed in the former will be virtually all the "Bligh's" propulsion equipment, including two marine boilers, two main turbogenerator sets, and two auxiliary turbogenerator sets. Included, also, will be related equipment such as feedwater, fuel-oil and lubricating pumps. This equipment will be installed in relatively the same position it formerly occupied in the "Bligh's" forward and aft engine rooms. As a result, it has been possible to salvage and use piping and other connections. The test section of the compressor-test laboratory will house two test cells. Each will contain a 5,500-hp. electric motor, with an overspeed rating of 7,500-hp. speed-increasing gear, Maxim silencer-equipped air intake and exhausts, and a wide variety of instruments for testing turbine compressors.

The compressor-test laboratory unit will be of concrete and steel construction, resting upon piling driven to a depth of 100 ft. The power-plant section will be two stories high and the test area one story. The floors will be several feet above the highest recorded flood level. Pratt & Whitney engineers disclosed that when the complete gas-turbine laboratory is operating, it will be necessary to pump 125,000 gal. of water per min. from the river to it and then return the water to the river. Tests for performance and durability will be conducted under widely varying conditions, including simulated high altitudes up to 40,000 ft., temperature extremes from −70° to 2,000°F., and speed effects up to 500 m.p.h.

Plans for the gas-turbine laboratory call for a building 263 ft. wide and 425 ft. long which could be expanded on all four sides. Two stories in height, the structure will be divided into four main areas. These will include a large test-stand and engine-preparation section; a service equipment space housing air compressors, exhausters, ram blowers, refrigeration units and turbogenerator sets; a boiler house containing three oil-fired marine boilers and a burner test-stand area. The building frame will be of structural steel except in the test-cell and burner-stand areas where reinforced concrete will be utilized.

Sections and Branches

Buffalo Section

A Valentine Day dinner-dance was held at the Buffalo Trap and Field Club by the Buffalo Section on February 14. The event was attended by 200 members and guests.

Detroit Section

By Robert Dale, *Secretary*

Chairman T. N. Kelly opened the meeting on February 5 with a few remarks concerning the interests of some

of the Section members, now employed in the automotive and power-plant industries, who are using aircraft technique and aeronautical engineering principles.

The first speaker, William Norwick, Standards Engineer, Fisher Body Division, General Motors Corporation, gave a paper on weight control of automobile bodies. Mr. Norwick outlined the design changes and corresponding weight increases in bodies over a 10-year period. These figures then were used to show how cost increase or decrease could be computed. He also showed by slides how the weight-control department could compile reports, using a punched card system, and complete a job within 2 or 3 hours. These reports then could be used by the engineering department or management in deciding the trend or course they should follow in any new design submitted.

Mr. Norwick discussed the use of materials, other than steel, for lighter constructed bodies. His remarks were general but did imply that at present no material is available which is superior to steel, particularly from a fabrication standpoint.

Mr. Kelly then introduced William Bean, Structures Engineer, Continental Motor Corporation, who presented a paper, "Strength Analysis of Internal Combustion Engines." A series of color slides accompanied Mr. Bean's paper. He explained how engines were analyzed by examining various components of the engine. Crankshafts, before and after analysis, were shown, indicating how these devices could be used to produce a product far superior to any known today. Three points were covered by Mr. Bean: operating stresses, shape or geometry of the parts, and material strength. He showed how the operating stress of a crankshaft could be recorded or checked in a running engine in flight, either by an engineer in the airplane or on the ground.

The meeting was then opened to questions from the floor. During this period many interesting points were brought up: lighter wheels and the use of aluminum in automobiles; nitriding of engine parts; elimination of polishing of engine parts; present efficiency of design; and processing of engines.

On March 5 Mr. Kelly opened the meeting with some observations on the problems of bringing landing aircraft to a stop and of taxiing difficulties. He then introduced H. H. Kerr, who presented a paper, accompanied by slides, concerning aircraft wheels, tires, and brakes. First Mr. Kerr discussed the various problems in brake drum design, indicating the types of materials used and failures that have resulted in the past. Next he discussed the various brake mechanisms that have been used and the difficulties with each. Methods of testing were then outlined, both proof and destructive. To demonstrate the method now being used, slides were shown on the static test of a complete assembly of tire, wheel, and brake; the primary objective being the testing of the brake.

Mr. Kerr then presented some data on a series of landing tests which were run on a B-34. His discussion dealt with a combination of braking procedures. Reverse-pitch propellers were used on the airplane combined with a series of brake combinations. Using both propellers and brakes, they were able to bring the airplane, landing at 98 m.p.h., to a stop in a distance of 998 ft. From these tests it was concluded that in airplanes of this type, reverse-pitch propellers operating at approximately 30 per cent power would allow the elimination of approximately one-half the present brake and thus save about 400 lbs. of weight in the airplane. A discussion and question period followed.

Calendar

I.A.S. Section Meetings

BUFFALO—MAY 22
Niagara Room, Statler Hotel
Speaker: Dr. Alexander Klemin
"Present Status of Helicopter Performance and Design"

DETROIT—MAY 7
Rackham Memorial Building
Business Meeting—Election of Officers

LOS ANGELES—MAY 1
Eaton's Restaurant
Speaker: Clarence L. Johnson, Lockheed Aircraft Corp.
"Development of Lockheed P-80 Fighter Airplane"

PHILADELPHIA—MAY 20
Engineer's Club of Philadelphia
Speaker: Herbert Spey, Naval Air Modification Unit
"Operational Experience with Guided Missiles"

WASHINGTON—MAY 14
U.S. Chamber of Commerce Building
Speaker: M. Gough, N.A.C.A.
"Establishment of Handling Qualities for Aircraft"

New York Section

By Otto E. Kirchner, *Secretary*

Joseph Lyman, of Sperry Gyroscope Company, Inc., spoke on the Sperry Automatic Landing Aids before a group of 200 engineers at the McAlpin Hotel on February 19. This development, which started in 1937, uses microwaves to give a restricted and sharp beam, down which the pilot orientates himself in the landing procedures. Mr. Lyman pointed out that certain work must still be done with reference to the glide path near the ground position in order to rely entirely on automatic landings. He also minimized the popular tendency to contrast the merits of the I.L.S. and the G.C.A. systems, which he feels complement each other. The G.C.A. has its place in monitoring the I.L.S. system and both can be of considerable service as a landing aid for air-transport operation.

Captain Arthur S. Born, U.S. Navy, explained the Navy philosophy with regard to landing aids. He stated that it was their aim to hold to a minimum the need for added equipment carried on the aircraft: "....the airplanes should be capable of carrying a maximum bomb load." The Navy's experience was that the I.L.S. system had definite limitations for aircraft-carrier operation and that the G.C.A. was better suited to their needs. There are, in general, two types of G.C.A. systems—one used by the Army and that used by the Navy. A 24-hour around-the-clock operation using the Navy type G.C.A. requires 19 men, on on-call service 13 men. One of the principal objections of the C.A.A. and the air lines to the G.C.A. system is this relatively large number of necessary personnel. Certain difficulties are still being experienced with reference to surface wind effect on rotating antennae, a structural problem. The operation of the G.C.A. requires considerable training of ground-crew members and complicates the personnel procurement problem. The Navy feels that the G.C.A. system requires less intense concentration and skill on the part of the pilot during instrument approaches than many other systems, and is therefore highly desirable from a military point of view. It is also believed that radar has a definite place in Navy operation and the Navy is working in close cooperation with American Airlines on research toward developing this flying aid for instrument-weather and navigational uses.

With reference to long-range uses, the Army and Navy both rely on the loran system as differentiated from the Decca system used by the British. It is the opinion of Captain Born that the loran system is less subject to jamming. The talks were followed by a general discussion, during which Dave Little (A.A.L.) summarized the

air-lines' point of view regarding the subjects discussed.

Philadelphia Section

By Seymour Gottlieb, *Secretary*

A business meeting was held at the Engineers Club of Philadelphia on February 11. H. Russell Young, Baldwin Locomotive Works, was elected Vice-Chairman of the Section to fill the vacancy left by L. B. Kalinowski. Arrangements were completed for the February 25 meeting. A plan for motion pictures to be shown after each meeting was selected. Arrangements are being made for a paper on guided missiles for the May 20 meeting.

Further efforts will be made to obtain a larger meeting room for a price within the budget. It was decided that regular notices will be sent to the universities in the area to stimulate student participation in the meetings.

Washington Section

J. P. Perry, Chief Engineer, Firestone Aircraft Company, presented a paper titled "Development of the Helicopter," at the February 12 Section meeting at the U.S. Chamber of Commerce Building. Preston R. Bassett, President of the Institute, and S. Paul Johnston, Director, were present and spoke briefly at the conclusion of Mr. Perry's paper.

Academy of Aeronautics

On February 4, Mr. Van Dyne, Field Representative, Wright Aeronautical Corporation, provided a commentary to *Power House of Aviation*, a cinematic tour through the Wright plants. Emphasis was placed on the manufacture of radial aircraft engines. After the film, Mr. Van Dyne conducted an informal discussion on Wright engines.

Thirty-five members attended a business meeting, February 18. At a graduation banquet held at the Hawk-Nest, La Guardia Field, the Senior Lecture and Scholastic Awards were presented. The presentation was made by Lt. Col. Hartung, Director of the Academy of Aeronautics. Miss Margaret Liebhauser received the Lecture Award and Roy M. Bistline received the Scholastic Award.

On March 3 the following officers were elected: Chairman, John L. Feltman; Vice-Chairman, Arthur P. Coletta; Treasurer, Richard A. Mazourek; Secretary, Paul F. Nenninger; and Sergeant at Arms, Joseph E. Reich.

Aeronautical University

On February 12 an informative paper, "Aircraft Gas Turbines," was presented by Raymond E. Small, Installation and Design Project Engineer, General Electric Company. A discussion of the design problems encountered in the development of gas turbines and ram-jets followed.

A Walt Disney film on jet propulsion, produced at Muroc Army Air Base, demonstrated the performance of the P-80. Five hundred members and guests attended.

Catholic University of America

A regular meeting was held February 19 in the Aeronautical Engineering Laboratory. Plans were discussed for promoting a better library in the department. Two films were shown: a Bell Aircraft Corporation film dealing with their experiments with remote-controlled aircraft and an A.A.F. film on the destruction of Ploesti. J. Wamser presented a paper on "Airfoils and Airflow." This was followed by an open discussion.

University of Cincinnati

On February 5 Bradley Jones, Professor of Aeronautical Engineering at the University, reported on his trip to the Institute Meeting in New York. A party was held at Mt. Airy Lodge, February 7, for Student Branch members. Seventy members and guests attended.

Chairman Arthur C. Nolte presided at the February 20 meeting, held at the Student Union Building. A Bell Aircraft Corporation film, *The Story of the P-59*, was shown. On February 27, members met to see an Army film, *The Wings of the Army*.

Georgia School of Technology

A trip to the shops and offices of Delta Airlines at the Atlanta Municipal Airport was sponsored by the Student Branch on January 10.

Chairman Lamar A. Ramos, Jr., presided at a meeting January 14. The film, *A Thunderbolt Is Made*, describing the production of the Republic P-47, was shown.

A party for student members and members of the faculty of the Aeronautical Engineering Department was held January 24. On January 27 George K. Williams, Associate Professor of Aeronautical Engineering, commented on the film, *PBM-3 Wing Destruction Test*, which was later shown. *Silent Wings*, a film dealing with sailplanes, was shown at the February 4 meeting.

The G.C.A. instrument landing system was described and demonstrated in a film, *GCA*, at a meeting February 18. It was decided at this meeting to present the Aeronautical Engineering Library with a book of pictures in color of all airplanes built in recent years.

University of Illinois

The following officers for the Spring Semester were elected at a meeting February 11: Chairman, A. Donald Swanson; Vice-Chairman, John R. McGuire; and Secretary-Treasurer, John Prodan. The Meeting and Papers Committee and the Membership Committee were re-elected to serve throughout the Spring Semester.

Indiana Technical College

On February 18 the Student Branch held its winter-term banquet at the English Terrace Tea Room. Ellsworth L. Olcott, Investigator for the Allen County, Ind., Trustees Office, spoke on the factors that govern the progress of science and the nation. The following new officers were formally presented at the banquet: Chairman, Robert R. Marshall; Vice-Chairman, George Thomas; Treasurer, John M. Zorad; and Secretary, John L. Weider.

University of Michigan

Ninety-five members and guests attended a meeting February 19 at the University of Michigan Union. R. Schneyer, Construction Supervisor of the supersonic wind tunnel at Willow Run Airport, gave a talk on the construction and technical difficulties encountered in supersonic wind tunnels.

The following officers were elected: Chairman, Maurice P. Murphy; Vice-Chairman, Herbert G. Hurrell; Secretary, Earl C. Willhoft; Treasurer, Albert E. Trapp; and Student Council Representative, Karl Stevens. A German film describing turbojets was shown.

University of Minnesota

A combined meeting of the Flying Club and the I.A.S. Student Branch was held January 29 at the Union Building. Earle Smith, C.A.B., Air Safety Investigation, discussed some of the causes of aircraft accidents. Following Mr. Smith's talk the faculty and students discussed the technique of making downwind turns. Doughnuts and coffee were served. On February 6 plans were made for an I.A.S. party. Two committees were ap-

pointed to arrange for a banquet to take place in the near future.

On February 20, 180 members and guests attended a meeting at Vincent Hall. Ben Cohn, Chief of Aerodynamics, Boeing Aircraft Company, Seattle, described the various departments at Boeing. He traced an airplane through its various stages in the engineering department. Emphasis was placed on the problems the graduating students would soon encounter.

It was decided that a banquet and dance would be held March 3 at the Union of the University.

Mississippi State College

The initial meeting of the Mississippi State College Branch was held January 29 in the Engineering Building. The first business considered was election of officers. The following students were elected: Chairman, Robert Lee Liddell; Vice-Chairman, Harry C. Smith; Treasurer, Robert E. Sizemore; Recording Secretary, Euell M. Vinson; and Corresponding Secretary, Franklin Hall Butler. F. S. Edwards was selected as Honorary Chairman and faculty advisor.

With the newly elected Chairman presiding, the governing By-laws were read, discussed, and amended by the members. Chairman Liddell appointed a group of three to act as a Membership Committee.

Ohio State University

On January 14, Lt. Col. Richard L. Walker, Professor of Air Science and Tactics, Ohio State University, spoke to members of the Student Branch on "Drone Aircraft." With the use of blackboard sketches and Air Force films he described the progress made in the development and use of drone aircraft from 1938 to the time of "Operation Crossroads." Another film, *The Last Bomb*, describing the operations of B-29's over Japan, was also shown.

One hundred members and guests attended a meeting January 28. Dr. George H. Shortley, Professor, Department of Physics, spoke on "Principles of the Supersonic Wind Tunnel." He described his experiences in moving German wind tunnels to this country and the problems of installation. He then gave a short résumé of the history of the development of the supersonic wind tunnel and of the problems of supersonic flight. Following Dr. Shortley's talk the meeting was opened for discussion. Ray Link was elected Vice-Chairman.

Dr. George Krouse, President, Krouse Testing Machine Company, Columbus, delivered a paper, "Metal Fatigue," at a meeting February 11. Dr. Krouse described and showed slides of the testing machines manufactured by his company. The Vice-Chairman announced that the Branch had been contacted by the Engineering College Council to elect a Junior and a Senior representative. It was decided to hold an election for these offices at the next meeting.

Captain Carlo R. Tosti, A.A.F., Engineering Control Officer, Power Plant Laboratory, Wright Field, Dayton, spoke on "Jet Propulsion," February 25, at the Campbell Hall Auditorium. Captain Tosti showed two films, *A.A.F. Comes of Age*, and *Aeronautical Oddities*.

It was proposed that a tour be made through the N.A.C.A. Laboratories in Cleveland in April.

University of Oklahoma

The following new officers were elected at the February 18 meeting, held in the University's Engineering Building: Chairman, Jack C. Bass; Vice-Chairman, Robert F. Faulkner; and Secretary-Treasurer, Clarren A. Brandenburgh. In an open discussion members offered suggestions for making the organization more helpful to the members. The services of The Paul Kollsman Library were described.

Parks College of Aeronautical Technology

Fifty members attended the first meeting of this Branch. Membership cards and emblems were distributed by Chairman Charles F. Jahn. The technicolor film, *A Report on Jet Propulsion*, was shown.

Purdue University

On February 25, Everett "Bud" Thompson, Field Representative, Allison Division, General Motors Corporation, spoke to 125 members and guests at the Purdue Physics Building. He described the test and operation of the J-33 jet engine as used in the P-80. Following the showing of slides, the meeting was opened for questions and general discussion. Chairman Robert E. Sawyer introduced the new officers to members. The Honorary Chairman, Dr. J. R. Weske, described the Institute and its functions for the benefit of the new members.

Rensselaer Polytechnic Institute

The first meeting of the spring semester was held February 27 in the Ricketts Building. Ninety members and guests attended. Dr. Alexander Klemin, Fellow of the Institute, spoke on the "Present Status of Helicopter Development."

Spartan College

Chairman Donald Maddocks presided at a business meeting, January 15, in the Engineering Building. A general discussion included the following projects: methods of improving the financial status of the Branch; possibility of presenting graduation rings; choice of future speakers; and selection of films.

On January 30 it was decided to invite the entire Engineering Student department to the showing of two films, *A Thunderbolt Is Made*, and *Bell Helicopter*. Sixty-five students of the Engineering College attended the showing of technical films Feb. 5.

Stewart Technical School

Two films, *Power by Wright*, and *PBM-3 Wing Destruction Test*, were shown at a meeting February 20 at the Stewart Technical Lecture Room. It was decided to plan a series of talks by students who are former Air Corps men. Many of the members volunteered and a schedule was drawn up.

Raymond Canavarro resigned his position as Vice-Chairman and Gerald J. Matarazzo, Jr., was elected to his post.

Tri-State College

Ceilings Unlimited, which traces the history of aircraft from the Wright Brothers' first craft up to the present jet-propelled plane, was shown at a meeting February 26. Thirty-five members attended.

University of Tulsa

Robert Fred Mitchell was elected Chairman of the Branch at a meeting February 12 in the Phillips Engineering Building. O. L. Deardorff is the new Vice-Chairman. It was decided to hold meetings on alternate Wednesdays at 7:15 p.m. Plans were made for student participation in Student Branch programs and members were asked to prepare technical papers.

On February 25 Arnol Sellars and Bill Burkitt spoke on "Jet Engines." Larry Pranter outlined the proposed activities of a Flying Club. The following Branch activities were planned: acquisition of films from manufacturers; a tour of the Piper Aircraft Corporation at Ponca City, Okla.; and an investigation of the possibility of sending a representative to the I.A.S. Aircraft Propulsion Meeting in Cleveland.

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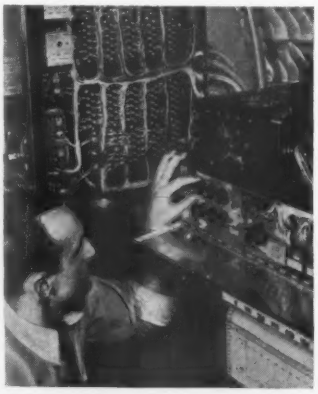

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Virginia Polytechnic Institute

Two talks were delivered at a meeting February 10. Professor Leon Z. Seltzer, head of the Aeronautics Department, reported on the I.A.S. Annual Meeting. Y. C. Yang, also of the Aeronautics Department, presented a series of abstracts from the following papers: "Laminar Boundary-Layer Oscillations," "A Method of Calculating Airfoil Sections from Specifications on the Pressure Distribution," "The Use of Damping Screens for Reduction of Wind-Tunnel Turbulence," and "Raydist—A Radio Navigation and Tracking System." Sixty-five members attended.

On February 17 a Navy film of the Navy's jet-propelled airplane, *The Phantom*, was shown. Following the Student Branch meeting the members attended a film, *Jet Propulsion*, which was shown to the combined A.S.M.E. and I.A.S. organizations by a representative of General Electric Co.

W. B. Houchens received the I.A.S. Scholarship award at the March 3 meeting. Following the presentation, a film entitled *A.A.F. Comes of Age*, was shown. This film dealt with the development of the Air Corps from "Pearl Harbor" to the "Atomic Bomb."

University of Washington

On January 30 Trygve Hoff, Group Engineer, Stress Section, Boeing Aircraft Company, spoke to 101 members of the Student Branch at the Guggenheim Auditorium, Seattle. The title of Mr. Hoff's speech was "Economic Future for Engineers on the West Coast."

A special meeting was held February 4 for the purpose of showing *N.A.C.A. Film on Compressibility*. This film deals with the development of shock waves around an airfoil at Mach Numbers of 0.5 to 0.8 and at various angles of attack. The shock waves shown in the film were photographed by the Schlieren interferometer method.

News of Members

The primary purpose of these columns is to record the current activities of Institute members and provide information that is of interest and value to other members.

All members are invited (in fact, urged) to send in releases or letters promptly informing the editors of any changes in positions, promotions, achievements, or other news items.

Robert Ashton, former Manager, Aircraft Repair Factory, Brooklands Aviation Ltd., England, is now Superintendent of Training, at Skyways, Ltd.

Maurice A. Biot, who before the war was Assistant Professor of Mechanics at Columbia University, is now Professor of Applied Physical Sciences at Brown University.

Dr. Karl T. Compton, President of the Massachusetts Institute of Technology, has been appointed Chairman of the Guided Missiles Committee of the newly established Army-Navy Joint Research and Development Board.

Frederick J. DeMeritte, formerly affiliated with the Chance Vought Aircraft Division, United Aircraft Corporation, as an Aeronautical Engineer, has joined The Glenn L. Martin Company as an Aerodynamicist.

Alfred R. Deptula is now an Engineering Instructor at Fenn College, Cleveland.

Henry C. Flagg is now a partner in the firm of Flagg & Robinson. He was formerly Structural Test Engineer at Grumman Aircraft Engineering Corporation.

Dr. Naftali F. Frenkiel, former Chief of the Groupement des Recherches Aéronautiques in France, has joined the staff of Cornell University.

Irving Friedman, Tri-State College graduate, has recently been promoted to the rank of Chief Aeronautical Engineer for Peninsular Air Transport, now operating continental and intercontinental routes.

Frank J. Gardiner has completed his service with the Bureau of Aeronautics, Navy Department, and is now an Engineer in the Special Products Division, I-T-E Circuit Breaker Company.

Theodore R. Goodman is now an Aerodynamicist at the Cornell Aeronautical Laboratory.

Frederick A. Hiersch is affiliated with Continental Aviation and Engineering Corporation as a Thermodynamicist. He was formerly a Senior Project Engineer at AL-FIN Corporation.

Sanford H. Hinton, formerly Supervisor of Engineering and Flight Analysis for American Airlines System and author of the air transport text, *Cruise Control*, has joined the staff of Luttrell & Senior, Inc., Air Transportation Managers, Engineers, and Consultants.

Thomas A. Knowles.

Robert W. Johnson, former Detail Engineer at Boeing Airplane Company, is instructing at Iowa State College.

W. Wallace Kellett, President of Kellett Aircraft Corporation, has been elected to the Board of Directors of Aircooled Motors, Inc., manufacturers of Franklin aircraft engines. Mr. Kellett is also a Director of Aircooled Motors' parent company, Republic Aviation Corporation.

Alexander Klemin, distinguished Professor of Aerodynamics, has been awarded an Honorary Fellowship by the American Helicopter Society. The presentation was made in recognition of the "outstanding contributions" made by the recipient to rotary wing aircraft.

Thomas A. Knowles has been elected Vice-President and General Manager of the Goodyear Aircraft Corporation.

Charles I. Lewis, former Flight Test Engineer, Aerodynamics Department, Airplane Division of Curtiss-Wright Corporation, is now Manager of the McCabe & Lewis Plating Company.

Robert C. Lewis has been appointed a Staff Member of the Aero-Elastic Research Laboratory, Massachusetts Institute of Technology.

Andrew D. Lim-Yuen is now a Group Leader at Canadair Ltd.

Wendell W. Lowry, affiliated with the United Airlines Engineering Department, has been promoted from Draftsman to Aircraft Engineer.

Charles H. Marshall, formerly Chief Design Engineer, Curtiss-Wright Corporation, is now Vice-President of George E. Wells, Inc.

Frederick H. Matteson is connected with the Ames Aeronautical Laboratory, N.A.C.A., as an Aeronautical Engineer.

Arthur McCabe is now affiliated with Douglas Aircraft Company, Inc., Santa Monica, as an Aerodynamicist.

Edwin B. McNeil is an Engineer in the Louisiana Division of the Standard Oil Company of New Jersey.

Leonard Meyerhoff is now associated with the Polytechnic Institute of Brooklyn as a Senior Research Associate. He was

formerly connected with the Propeller Division of Curtiss-Wright Corporation.

Maurice Nelles has been appointed Professor of Aeronautics at the new College of Aeronautics currently being established at Santa Maria, Calif., by the University of Southern California.

Garrett D. Pagon, formerly associated with the Edward G. Budd Mfg. Company, is now Project Engineer in the Development Division of the Budd Company.

John L. Palmer is at present a Research Laboratory Analyst at the Hughes Aircraft Company.

Wayne W. Parrish, Editor and Publisher of the American Aviation Publications, has resigned as a trustee of Air Affairs, Inc., publishers of the Air Affairs quarterly.

Arthur N. Paul, former Stress Analyst, Arizona Division of the Goodyear Aircraft Corporation, is now an instructor at Purdue University.

Carroll J. Peirce, Jr., Chief of Aerodynamics, Boeing Airplane Company, Wichita, Kan., has been appointed Director of the Ohio State University School of Aviation. As head of the School, Mr. Peirce will lead in development of the University's extensive aviation program.

Raymond A. Pepping has joined the McDonnell Aircraft Corporation as Chief of Flutter and Vibration.

Frank N. Piasecki, President of Piasecki Helicopter Corporation, was elected Honorary Fellow of the American Helicopter Society at their annual Honors Night Dinner held in the Ambassador Hotel, New York City. This award was made to Mr. Piasecki for "his outstanding achievement and work in the development of a successful new departure in helicopter design and the advancement of the helicopter art." Mr. Piasecki credited the company's achievements primarily to the successful coordination and understanding between management and engineering. He pointed out the continuing need for appreciation of engineering problems by management.

George E. Poorman is engaged in Design Research in the Preliminary Airplane Design Branch, Bureau of Aeronautics.

Frank N. Piasecki.

B. R. Teree.

He was formerly a Research Engineer in the Curtiss Aeroplane Division of Curtiss-Wright Corporation.

W. A. Reichel, formerly Director of Engineering at Eclipse-Pioneer Division, Bendix Aviation Corporation, has become Vice-President of the Kearfott Engineering Company.

Orville L. Richardson has been promoted to Senior Aerodynamicist at The Glenn L. Martin Company.

Albert B. Scoles, Captain, U.S. Navy, is Commanding Officer and Director of Tests at the newly established Naval Air Missile Test Center, Point Mugu, Calif.

Elgin L. Shaw, formerly in charge of Development and Research and Stress Analysis, Goodyear Aircraft Corporation, is now President of the General Development Corporation.

Wilfred H. Shaw is at present a Service Engineer, Hamilton Standard Propellers Division, United Aircraft Corporation.

Igor I. Sikorsky, Engineering Manager of Sikorsky Aircraft Division, United Aircraft Corporation, has been awarded the Gold Medal of the Fédération Aéronautique Internationale for outstanding aeronautical achievement in 1946. The medal is awarded "to those who in the course of the preceding year shall have contributed exceedingly by their action, their work, their performance, their initiative, or their zeal, to the progress and development of aeronautics."

Alfred Skrobisch, former Chief Research Engineer, Eastern Air Devices, Inc., has become a Partner in Technical Advisory Associates.

Eugene Stolarik has resigned his position as Chief Engineer of the U.S. Navy Office of Research and Inventions Laboratory, Port Washington, N.Y., and has accepted an Associate Professorship in the Department of Aeronautical Engineering, University of Minnesota.

Raynor F. Sturgis, Jr., former head of Technical Section—Contacts Division, Kellett Aircraft Corporation, is now affiliated with Booz, Allen & Hamilton, as a Consultant.

B. R. Teree has been appointed to the position of Laboratory Director of The Weatherhead Company, Cleveland. He was formerly Project Engineer in charge of Aircraft Development. Before joining Weatherhead, Mr. Teree was in charge of all Curtiss-Wright experimental and production design of hydraulics, landing gears, tail wheels, and arresting gears.

Hsue-Chu Tsien, former Lieutenant Colonel in the Procurement Division of the Chinese Air Force, is now Chief of the Industry and Mining Department of the Chinese Supply Commission.

Richard Wanner has transferred from Boeing Aircraft Company to Republic Aviation Corporation as an Aerodynamicist.

Leland D. Webb, U.S. Navy, retired, has been appointed Manager of the Western Region office of the Aircraft Industries Association of America. Captain Webb, who received the Legion of Merit from the Secretary of the Navy for "outstanding contribution to the war effort," has completed 38 years of naval service, the last 25 of which were in naval aviation.

Leonard W. Weiss, former Training Director at Brewster Aeronautical Corporation, is now General Manager, Industrial Conversions Inc.

Leslie W. Westerling, former Associate Professor of Advanced Airplane Design, Spartan School of Aeronautical Engineering, is now a Structures Engineer, Aeronca Aircraft Corporation.

Jean L. Ziegler has become Vice-President of United Services for Air, Inc. He was formerly a Test Pilot in the Airplane Div., Curtiss-Wright Corp.

Charles H. Zimmerman has been named Factory Manager of Goodyear Aircraft Corporation. Mr. Zimmerman joined Goodyear Tires' lighter-than-air division in 1917. In 1925 he moved into the Development Division of the Goodyear Zeppelin Corporation. He became manager of miscellaneous products design in 1937. This included the designing of airplane wheels and brakes. When wartime demands necessitated the organization of a separate wheel and brake division in 1942, Mr. Zimmerman was named manager.

Charles H. Zimmerman.

Members Elected

The following applicants for membership or applicants for change of previous grades were omitted from the March issue of the REVIEW because of space limitations. This list and the one immediately following include all applicants who have been admitted since publication of the list in the February issue.

Transferred to Associate Fellow Grade

Baker, Carl Frederic, B.S. in M.E.; Chief Engineer, Hamilton Standard Propellers Div., United Aircraft Corp.

Johnston, Robert Bethel, M.S. in M.E.; Chief of Aerodynamics, Ryan Aeronautical Co.

Nordlinger, Samuel Gerson, M.S.; Chief of Unconventional Power Plants Engineering, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp.

Price, Robert Allen, Asst. Project Engineer, Helicopter and Jet Research Div., McDonnell Aircraft Corp.

Richardson, Lawrence Baxter, M.S.; Executive Asst. to the President, Curtiss-Wright Corp.

Townsend, Neville Austin, Asst. Chief Technician, Portsmouth Aviation, Ltd. (England).

Elected to MEMBER Grade

Adams, Spencer Moore, S.M.; Comdr., Head, Fuels and Lubricants Branch, Power Plant Div., Bureau of Aeronautics, U.S. Navy.

Aguilera, Enrique, B.S.; Owner, Enrique Aguilera—Exporting Aviation and Marine Products.

Allison, George Everett, A.B. in Eng.; Aeronautical Engineer, Ames Aero. Lab., N.A.C.A.

Blair, Ira Elmer, Engineer, Checker, Lockheed Aircraft Corp.

Boname, Robert Victor Louis, Manager, Aviation Dept., Columbia Commerce & Credit Corp.

Bourchier, Burton Jenner, M.E.; Manager, Aircraft Equipment, Canadian General Electric Co.

Bremer, Paul Henry, M.S.E.; Structures Engineer, Lockheed Aircraft Corp.

Campbell, Harry Albert.

Clapper, Robert B., B.S. in M.E.; Supervisor, Structures Dept., Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Clay, Eugene Oscar, Chief Designer, Culver Aircraft Corp.

Culver, Irven Harold, Design Specialist, Lockheed Aircraft Corp.

Dawson, Geoffrey Dean, B.E.; Manager, Engineering Div., Aeronautical Supply Co. Ltd. (Australia).

Draper, George William, Group Leader Flight Controls, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Duschik, Frank, B.Ae.E.; Aerodynamicist, Lockheed Aircraft Corp.

Eadon, Alan Theodore Eden, Lt. Col., National Provincial Bank Ltd. (England).

Fahrney, Delmer Stater, M.S.; Capt., Director of Pilotless Aircraft Div., Bureau of Aeronautics, U.S. Navy.

Fairbanks, Warren Evans, B.S. in Ae.E.; Aviation Engineer, Insurance Company of North America.

Frenkiel, Naftali Frangois, Dr.Sc.; Chief of a Research Group, Groupement des Recherches Aeronautiques (France).

Garayan, George Joseph, Engineer 1/C, Middle East Airlines Co.

Guiberson, Samuel Allen, III, President, The Guiberson Corp.

Harkness, John Reynolds, B.S. in E.E.; Chief Engineer, G. M. Giannini & Co., Inc.

Harrison, Harold Millard, B.S.; Division Engineer, Production Engineering, Lockheed Aircraft Corp.

Hauck, Hamilton Oscar, M.S. in Ae.E.; Comdr., U.S. Navy.

Kantor, Misha I., M.E.; The Strat Aircraft Corp.

Kasnicka, Edward John, B.S.; Asst. Engineering Manager, Lockheed Aircraft Corp.

Keats, Edgar Salo, B.S.; Comdr., Asst. Director of Armament Div., Bureau of Aeronautics, U.S. Navy.

Kirby, James Robert, B.S.; Stress Analyst, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Knapp, Norman Edward, M.S. in Ae.E.; Comdr., Chief Engineer, Research, Development & Test, Bureau of Aeronautics, U.S. Navy.

Kronmiller, George Hannibal, M.S.; Lt. Comdr., Officer in Charge of Engineering Div., Experimental Dept., U.S. Navy.

Levitt, Bernard Barclay, M.S. in Ae.E.

Mentzer, William Williams, B.S. in Ae.E.; Designer, Douglas Aircraft Co., Inc.

Miner, John Durward, Jr., B.Sc.; Manager, Aviation Engineering Dept., Westinghouse Electric Corp.

Ovadias, Peter, Ae.E.; Chief Aircraft Inspector and Instructor, Air Transport Command, U.S. Army Air Forces (Egypt).

Papen, George Washington, II, B.S.; Production Design Department Engineer, Lockheed Aircraft Corp.

Pillsbury, Elmore Parker, B.S. in Ae.E.; Chief Aerodynamicist, Kaiser Fleetwings, Inc.

Sieradzki, Henry Joseph, Sr., B.S. in Ae.E.; Project Structural Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Stowe, Lewis James, B.Ae.E.; Project Engineer, Chase Aircraft Co., Inc.

Stroukoff, Michael, C.E.; Chief Engineer, Chase Aircraft Co., Inc.

Turner, William Nathan, B.S. in M.E.; Aerodynamicist, North American Aviation, Inc.

Utsch, Albert, M.E.; Chief Designer, McDonnell Aircraft Corp.

Volluz, Raymond Julius, B.S. in M.E.; Aerodynamicist "A," Consolidated Vultee Aircraft Corp.

Wassall, John Brent, Chief Production Development Engineer, Lockheed Aircraft Corp.

Waterman, Logan Theodore, B.S. in C.E.; Aerodynamicist, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Wax, Charles Morris, Experimental Dept., Liaison Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Young, Dana, Ph.D.; Professor of Engineering Mechanics, The University of Texas.

Zielony, Alexander, B.Sc. in Ae.E.; Flight Lt., Engineer Officer on Wing H.Q. Staff, Royal Air Force.

Transferred to MEMBER Grade

Alexander, Sidney Raymond, B.Ae.E.; Aeronautical Engineer, Pilotless Aircraft Research Div., Langley Mem. Aero. Lab., N.A.C.A.

Ball, Joseph Norman, Jr., M.S.; Aerodynamicist, Chance Vought Aircraft Div., United Aircraft Corp.

Burdick, John Samuel, Jr., B.S. in M.E.; Design Analyst in Development Engineering Section, Sikorsky Aircraft Div., United Aircraft Corp.

Chawla, Jagannath Punnulal, M.S. in Ae.E.; Sr. Engineer, Flight Research Dept., Cornell Aeronautical Laboratory.

Cribb, Thomas George, Design Standards Engineer, Canadair Ltd. (Canada).

Davidson, Eugene Sahl, B.Ae.E.; Sales Engineer, Davidson Industrial Contracting Co.

Fredrick, J. Louis, M.S. in Ae.E.; Unit Head, Aerodynamics, Curtiss-Wright Corp. (Columbus Plant).

Hensel, Rudolph William, M.S. in Ae.E.; Capt., Engineer-in-Charge of the Wright Field 10-Ft. (High-Speed) Wind Tunnel, U.S. Army Air Forces.

Jacobson, Oliver Hansen, B.S. in M.E.; Research Engineer, Marquardt Aircraft Co.

Jordan, Donald John, B.S. in M.E.; Power Plant Staff Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Kramer, Edward Henry, B.Ae.E.; Aero. Engineer P-4, Air Matériel Command (Wright Field).

Kuns, Harold J., Ae.E.; Structures Engineer, Waco Aircraft Co.

Larson, Donald Charles, B.S. in Ae.E.; Research Asst.—Ordnance Research Lab., The Pennsylvania State College.

Meiselman, Sanford, B.Ae.E.; Sr. Aero. Engineer P-4, Air Mat´riel Command (Wright Field).

Moyer, William Harry, M.E.; Design Engineer, Fredric Flader, Inc.

Newberger, Eli Saul, B.Ae.E.; Aero. Engineer, C.A.A.

Nietsch, Herman Erich, B.S. in Ae.E.; Group Engineer (Vibration Dept.), The Glenn L. Martin Co.

Pavelka, Jerry, B.Ae.E.; Principal Aerodynamicist, Republic Aviation Corp.

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B	2 5/16"
C	3 3/8"
D	3 15/16"
E	4 3/4"
F	5 5/8"

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MANUFACTURERS OF B-W SUPERCHARGERS

Petrovsky, Alex, B.Ae.E.; Sr. Aerodynamicist, Republic Aviation Corp.

Pope, Alan Yates, M.S. in Ae.E.; Assoc. Professor of Aerodynamics, Georgia School of Technology.

Prentice, Bruce Robinson, B.S. in E.E.; Asst. to Vice President in Charge of Engineering Policy, Engineering & Policy Div., General Electric Co.

Rosen, Dexter, B.S. in Ae.E.; Special Assignments—Helicopter Engineering, Bell Aircraft Corp.

Saslowsky, Morris, M.E.; Project Engineer, Electrical Experimental Dept., Kollsman Instrument Div., Square D Co.

Spitzig, Francis Albert, B.Arch.; President, Francis A. Spitzig & Associates.

Street, Lloyd Joseph, B.Ae.E.; Flight Test Engineer, The Glenn L. Martin Co.

Van Nice, John Horace, B.A.; Design Engineer, Consolidated Vultee Aircraft Corp.

Wallace, Harry Howard, Jr., B.Ae.E.; Project Engineer, Chandler-Evans Corp.

Weaver, John Hibbard, B.S. in Ae.E.; Dept. Manager, Wind Tunnel, Lockheed Aircraft Corp.

Wolfsohn, Robert Smith, B.S. in M.E.; Sr. Mechanical Engineer, Air Matériel Command (Wright Field).

Elected to Associate Member Grade

Averill, Robert Guyer, President-Treasurer, Norseman Air Transport Inc.

Barrett, Leonard William, Technical Writer, Canadair Ltd. (Canada).

Bass, Walter McLain, B.S.; Asst. Chief Engineer, Pacific Airmotive Corp.

Braus, Robert Edward, Engineering Specialist, Preliminary Design Section, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Clark, Edward G., Asst. Group Leader, Power Plant (Exp. Dept.), Grumman Aircraft Engineering Corp.

Coney, William, Planner & Estimator (Int. grade), U.S. Navy.

Evans, Elma Theora, B.S.; Librarian, Cornell Aeronautical Laboratory.

Friedman, William Stefan, Technical Editor (Air Force Pub.), Phillip Andrews Publishing Co.

Gil Y Urrutia, Victor, Manager, Aviation Dept., Automotriz O'Farrill (Mexico).

Goss, Walter Myron, Sales Engineer, Western Gear Works.

McLaughlin, John Roy, M.E.; Technical Writer, Lockheed Aircraft Corp.

Rogers, John, Process Engineer for Aircraft Work & Superintendent, Metlab Company.

Solomon, Samuel Joseph, LL.B.; President, Atlantic Airlines, Inc.

Thomas, Walter Charles, Sr. Inspector of Aircraft, Grumman Aircraft Engineering Corp., Bureau of Aeronautics, Representing Navy Dept.

Turner, Warren Paul, Asst. to General Manager (Contract Administrator), Reaction Motors, Inc.

Watson, Edwin Penna, Flight Supt., Maritime Central Airways Ltd.

Wrede, Bertram Alfred, B.S. in C.E.; Specifications Engineer, Lockheed Aircraft Corp.

Wyatt, Jack Vincent, Liaison Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Elected to Technical Member Grade

Bone, Donald Walter, B.Ae.E.; Stress Analyst, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Buzza, Richard Stephen, B.S. in Ae.E.; Stress Analyst "B," Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Ellis, Gordon Wilfred, Engineering Draftsman, Helicopter Div., Bell Aircraft Corp.

Hoard, Richard James, B.S. in M.E.; Project Engineer, Western Gear Works.

Jaxheimer, William Henry, Jr., Mechanical Designer, Mitchell Div., United Specialties Co.

Perkinson, Robert Edward, B.Ae.E.; Instructor in Kinematics, Physics and Aerodynamics, Parks Air College.

Peterson, Benjamin Garth, B.S.; Aerodynamicist, North American Aviation, Inc.

Ramamritham, Subramania, B.Sc.; Scholar for Advanced Studies in Ae.E., Dept. of Education, India Government.

Rao, Kuchi Srihari Muralidhar, A.F.R.-Ae.S., B.Sc.; Sr. Inspector, Hindustan Aircraft Ltd. (India).

Rinaldi, Leonard Daniel, B.A. (Math.); Graduate Assistantship in Mathematics, Cornell University.

Rosenthal, Gordon, B.A.Sc.; Jr. Research Engineer, Aerodynamics Section, Mechanical Engineering Div., National Research Council (Canada).

Rush, Charles Kenneth, B.Sc. in M.E.; Jr. Research Engineer, National Research Council (Canada).

Steinberg, William Robert.

Taliberti, Augusto Octavio, C.E.

Tinsley, Walton Eugene, E.E.; Engineer, Servo Corp. of America.

Tomanik, Milan Andrew, Draftsman, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Transferred from Student to Technical Member

Adcock, Clifton Leon, B.S. in Ae.E.; Member Electrical Design Group, Consolidated Vultee Aircraft Corp.

Bird, King D., B.Ae.E.; Engineer, Structures Branch, Aircraft Lab., Air Matériel Command (Wright Field).

Breslauer, Lester Mitchell, B.Ae.E.; Computer, Flight Test Engineering Dept., Republic Aviation Corp.

Bunte, Betty Larue, S.B.; Aerodynamicist, Boeing Aircraft Co.

Chervenka, Calvin Coolidge, B.S. in Ae.E.; Engineering Draftsman, Douglas Aircraft Co., Inc.

Clark, Denver Dudley, B.S. in Ae.E.; Asst. Aerodynamicist, McDonnell Aircraft Corp.

Cooper, Gearld Keith, B.S. in Ae.E.; Instructor in Engineering Mechanics, Purdue University.

Crabtree, Charles Franklin, Jr., B.S.; Engineer Draftsman-Class "B," Consolidated Vultee Aircraft Corp.

DeBevoise, John Manley, M.S.; Aerodynamicist "A," Ryan Aeronautical Co.

Egner, George J., Jr., B.S. in Ae.E.; Graduate Student, Aeronautical University.

Gallagher, Edward Wesley, B.Ae.E.; Project Engineer, Wright Field (U.S. Govt.).

Glazier, Pauline Virginia, S.B.; Jr. Engineer, Boeing Aircraft Co.

Griffiths, Thomas James, B.S. in Ae.E.; Jr. Engineer, Curtiss-Wright Corp. (Columbus Plant).

Haring, William Ivan, B.Ae.E.; Draftsman "B," Consolidated Vultee Aircraft Corp.

Hosek, John Jerome, Jr., B.S. in Ae.E.; Jr. Test Engineer, The Glenn L. Martin Co.

Howard, Ephraim Manassen, B.S. in Ae.E.; Laboratory Research Work, Wayne University.

King, Thomas Jefferson, Jr., B.Ae.E.; Aeronautical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Kotonias, Theodore James, B.Ae.E.; Aeronautical Engineer, Aircraft Engine Research Lab., N.A.C.A.

La Fountain, Henry Charles, B.Ae.E.; Engineer P-1 (Wright Field) (U.S. Govt.).

Luke, Ernest Pemberton, B.S. in Ae.E.; Aeronautical Engineer, Flight Research Div., Langley Mem. Aero. Lab., N.A.C.A.

Marks, Clifford Dunham, B.S.

Miller, Leonard Michael, B.S. in Ae.E.; Teacher, Aeronautical University.

Mitchell, Nathan I., M.S. in Ae.E.; Aerodynamicist, Consolidated Vultee Aircraft Corp.

Moog, Richard Dana, B.Ae.E.; 1st Computer, Geophysical Service Inc.

Peake, Franklin Elmer, B.S.; Design Draftsman "A" (Wing Group), Douglas Aircraft Co., Inc.

Peugh, Darrel Eugene, B.S. in Ae.E.

Pocock, Philip John, Jr., S.B.; Jr. Research Engineer, Mechanical Engineering Div., National Research Council (Canada).

Ross, Franklin Jacob, B.Ae.E.; Research Asst., University of Minnesota.

Setzer, George Frederick, B.S.; Graduate Student, University of Minnesota.

Sterling, James Berkel, B.S. in Ae.E.; Stress Analyst, United Helicopters Inc.

The following applicants for membership or applicants for change of previous grades have been admitted since compilation of the preceding list.

Elected to Associate Fellow Grade

Allen, H. Julian, M.A.; Chief, High-Speed Research Div., Ames Aero. Lab., N.A.C.A.

Hughes, Arthur J., Managing Director, Henry Hughes & Son Ltd. (England).

Transferred to Associate Fellow Grade

Ashton, Benjamin Nicol, Jr., President and General Manager, Electrol Incorporated.

Mellinger, George Rolland, M.S. in Ae.E.; Asst. Chief of Flight Test, North American Aviation, Inc.

Roy, Maurice Paul, Dr. of Sc.; President of 2nd National Congress of French Aviation; Scientific and Technical Advisor of National Office of Aero. Research and Study, French Air Ministry (France).

Wolcott, Fred Wellington, B.S.E.; Chief Aerodynamicist, Long Beach Plant, Douglas Aircraft Co., Inc.

Elected to MEMBER Grade

Allen, Francis Vernon, Partner, Allen & Morrison.

Coulbourn, William Clarence, B.S.; Engineer in charge of Gyro and Servo Design, Norden Laboratories Corp.

Edholm, Robert Morris, M.S. in Ae.E.; Engineering Test Pilot, McDonnell Aircraft Corp.

Furry, Warren Gardner, Jr., B.S.C.E.; Vice-Pres., Baumann Aircraft Corp.

Gallery, Daniel Vincent, B.S.; Rear Adm., Asst. Chief of Naval Operations for Guided Missiles, U.S. Navy.

Gelb, John, Dipl. Ing. in M.E.; Chief Engineer, Diesel Engine Div., S. F. Bowser Ltd.

Hawkes, James Ellison, B.Sc. in Ae.E.; Flight Test Engineer, Lockheed Aircraft Corp.

Kilpatrick, Macgregor, B.S.; Lt. Comdr., Project Officer, VF Design Branch, Bureau of Aeronautics, U.S.Navy.

Korff, Walter Henry, Standards Engineer, Dept. Supervisor, Lockheed Aircraft Corp.

Lipow, Joseph H., B.S.; Research Engineer, Hughes Aircraft Co.

Lufloff, Johann F., Ph.D.; Asst. Prof. of Aeronautics, Dept. of Aeronautics, New York University.

Miles, Arthur Clark, M.S.; Rear Adm., U.S. Navy.

Morris, Mark M., C.E.; Research Lab. Analyst, Northrop Aircraft, Inc.

Newcomb, Robert Bradford Charles, B.S. in Ae.E.; Flight Test Design Engineer, Douglas Aircraft Co., Inc.

Newmark, Nathan Mortimore, Ph.D.; Research Prof. of Civil Engineering, University of Illinois.

Robinson, Jack McLean, A.A.; Engineering Designer "A," Douglas Aircraft Co., Inc.

Schindler, Cornelius, M.E.; Chief of Standards, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Simpler, Leroy C., B.S.; Capt., Asst. Director of Office of Public Information for Aviation, U.S. Navy.

Smith, Randall Clayton, B.S. in Ae.E.; Chief of Structures, East Coast Aeronautics, Inc.

Thorn, Gordon Phillips, B.S.; Flight Test Supervisor, Lockheed Aircraft Corp.

Tixier, Eugene E., Aero. Engineer, U.S.A. Rep., Chilean National Airlines.

Trigg, Leslie John, B.S. in Ae.E.; Chief Engineer, Sensenich Bros.

Weidenheimer, Norman William, B.S.-Mining Engineering; Staff Asst., (Project Engineer), Douglas Aircraft Co., Inc.

Williams, Claude Douglass, B.S. in C.E.; Asst. to Asst. Chief Engineer, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Williams, Gene Blohm, B.S. in Ae.E.; Lead Engineer, Boeing Aircraft Co.

Winchester, James Eugene, Chief Engineer, Slick Airways, Inc.

Yates, Alan Hazeltine, M.S. in Ae.E.; Lt. Comdr. (Naval Aviator), U.S. Navy.

Transferred to MEMBER Grade

Berman, Henry, B.S.; Stress Analyst, Republic Aviation Corp.

Blenkush, Philip George, B.Ae.E.; Instructor, Dept. of Aero. Engineering, University of Detroit.

Bockmann, Wilbur Howard, B.Ae.E.; Administrative Aerodynamicist, Pilotless Plane Div., Fairchild Engine and Airplane Corp.

Bowser, James Warren, B.S. in Ae.E.; Flight Test Instrumentation Engineer, Lockheed Aircraft Corp.

Cherniak, George Sadwin, S.M. in Ae.E.; Chief Engineer, Lessells and Associates.

Cherwony, Alexander, B.Ae.E.; Layout Draftsman, Republic Aviation Corp.

Covington, Donald Kingsley, Jr., B.S. in Ae.E.; Sr. Flight Test Engineer, Commercial Group Leader, The Glenn L. Martin Co.

Duppstadt, Jay Robert, B.S. in M.E.; Project Engineer, United Services for Air.

Frankel, Meyer Sam, B.Ae.E.; Design Engineer, Edo Aircraft Corp.

Golden, James Miles, B.S. in M.E.; Field Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Gough, Wm. Vernon, Jr., B.E. in M.E.; Engineer Test Pilot, Head, Pilot Sec., Wind Tunnel and Flight Research Div., Aircraft Engine Research Lab., N.A.C.A.

Guttmann, Karl Hans, M.Ae.E.; Research and Design Engineer, Ranger Aircraft Engines Div., Fairchild Engine and Airplane Corp.

Haar, Marvin I., B.A.; Mechanical Engineer (lab. operations), Langley Mem. Aero. Lab., N.A.C.A.

Height, Lewis Henry, Asst. Project Engineer, Lockheed Aircraft Corp.

Hersey, Donald Samuel, B.S. in Ae.E.; Engineering Asst. to Chief of Development, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Heyl, Edward Barry, B.S. in M.E.; Research Engineer, Aero Insurance Underwriters Inc.

Hruda, Richard Joseph, B.S. in C.E.; Stress Analyst, Lockheed Aircraft Corp.

Ignasiak, Bernard John, B.S. in Ae.E.; Project Stress Engineer, Bell Aircraft Corp.

Jarrett, Alfred LeRoy, B.Ae.E.; Performance Group Leader, Aerodynamics Dept., Chance Vought Aircraft Div., United Aircraft Corp.

Johnsen, Irving Almer, B.A.; Project Engineer, Aircraft Engine Research Lab., N.A.C.A.

Johnson, Walter Henry, M.S.; Program Engineer, Aberdeen Supersonic Wind Tunnels Lab. (Md.)

Kaman, Charles Huron, B.Ae.E.; President and Chairman, Kaman Aircraft Corp.

Kamm, Robert William, B.Ae.E.; Sr. Aerodynamicist, The Glenn L. Martin Co.

Kelley, Edward Frederick, M.S.; Compressed Gas Dept., Engineer Board (Ft. Belvoir, Va.).

Lu, Hoshen Richard, M.S.; Principal Aerodynamicist, Republic Aviation Corp.

Meyer, William Francis, B.Ae.E.; Sr. Structures Engineer, Propeller Div., Curtiss-Wright Corp.

Neustein, Joseph, M.S. in M.E.; Mechanical Engineer P-4, Aircraft Engine Research Lab., N.A.C.A.

Northrup, John Laurence, B.S. in Ae.E.; Staff Engineer, Goodyear Aircraft Corp.

Parker, Willard Wood, B.Ae.E.; Secretary-Treasurer, Green Lake Airports.

Pengelley, Charles Desmond, S.M.; Head, Flutter and Vibration Section, Columbus Plant, Curtiss-Wright Corp.

Pepper, Edward, B.S. in M.E.; Aeronautical Engineer, Naval Aircraft Modification Unit (Johnsville, Pa.).

Reagan, James F., Ph.D.; Sr. Project Engineer, Bendix Aviation Corp.

Richardson, David Allen, S.B. in Ae.E.; Design Engineer, Kellett Aircraft Corp.

Robinson, James Dungan, Jr., Pratt & Whitney Aircraft Div., United Aircraft Corp.

Roden, B., M.Sc. in Ae.E.; A. V. Roe Canada Ltd. (Canada).

Roelke, Charles Theodore, B.E. in M.E.; Asst. Chief, Eastern Field Engineering, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Senior, John Lawson, Jr., B.S. in Ae.E.; Vice-President and Treas., Luttrell & Senior, Inc.

Shevell, Richard Shepard, Ae.E.; Aerodynamics Engineer, Douglas Aircraft Co., Inc.

Shuler, William T., M.S. in Ae.E.; Structural Engineer, C.A.A.

Stewart, Homer Joseph, Ph.D. in Ae.E.; Assoc. Prof. of Aeronautics and Meteorology, California Institute of Technology.

Towle, Charles John, B.Ae.E.; Design Engineer, Group Leader on Wings, Grumman Aircraft Engineering Corp.

Turner, Marion Jonathan, M.Ae.E.; Sr. Project Analytical Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Yudewitz, Samuel, M.Ae.E.; Air Matériel Command, U.S. Army Air Forces.

Elected to Associate Member Grade

Bicknell, Nigel, M.A.; Asst. Civil Air Attaché, U.K. Ministry of Civil Aviation (Wing Commander, R.A.F. Volunteer Reserve).

Droutzkoy, Alexis Alexander, B.A.; President and Editor, *American Helicopter Magazine, Inc.*

Giles, Cedric Byron, New York Telephone Co.

Granger, Byrd Howell, A.B.; Independent Aviation Writer.

Samson, David P., Jr., Project Administrative Engineer, The Glenn L. Martin Co.

Schaff, Cletus Peter, Bur. of Aero. Resident Rep. at Fairchild Aircraft, Bureau of Aeronautics, Navy Dept.

Shaw, Francis, President, Shaw Metal Products Corp.

Straight, James Luther, Manager, Western Region, Institute of the Aeronautical Sciences, Inc.

Warner, William Vaughn, "A" Draftsman, Lockheed Aircraft Corp.

Whitney, Orrin Jay, President, Aero Counsellors.

Elected to Technical Member Grade

Altenhaus, Julian Le-Roi, B.S., Ae.E.; Jr. Engineer, Propeller Div., Curtiss-Wright Corp.

Boffola, Frank Paul, B.S.E., Ae.E.; Aeronautical Engineer, Bureau of Aeronautics, Navy Dept.

Calderone, Augustus Charles, B. of Applied Science and Engineering; Application Engineer, Canadian General Electric Co.

Cheater, Roy, Technical Asst., Portsmouth Aviation Ltd. (England).

Conrard, Donald, B.S. in Ae.E.; Aeronautical Engineer, Ames Aero. Lab., N.A.C.A.

D'Arcy, Donald Frederick, B.A.Sc.; Engineer, A. V. Roe Canada Limited.

Garraway, Derek Roger, B.Sc.; Technician, The Fairey Aviation Company, Hayes (England).

Hansen, Matt Joseph, Engineering Draftsman "A," North American Aviation, Inc.

McGinness, Houston DeWitt, B.S.; Engineering Designer, Lockheed Aircraft Corp.

McMurry, Thomas Richard, B.S.; Liaison Engineer, Douglas Aircraft Co., Inc.

Morris, Deane Northrup, B.S. in M.E.; Aerodynamicist, Bell Aircraft Corp.

Pavel, John Thomas, B.S. in Ae.E.; Test Engineer (Eng. Labs.), Bell Aircraft Corp.

Perlman, Eliah Pincus, B.S. in Ae.E.; Aero. Engineer, Bureau of Aeronautics, U.S. Navy.

Shephard, Frank Leslie, B.S. in M.E.; Mechanical Engineer, U.S. Civil Service, War Dept. (Wright Field).

Shusterich, Ludwig M., B.S. in Ae.E.; Consultant Engineer, Tesco Engineering Co. (Affiliated), also organized consultant engineering firm.

Tamkin, S. Jerome, Research Engineer, Navy Research Project, University of Southern California.

Wallace, Frederick Earl, Jr., Aircraft Draftsman, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Transferred from Student to Technical Member

Bartoo, Wallace Hubert, B.Ae.E.; Jr. Engineer, Boeing Aircraft Co.

Bistline, Roy Markley.

Corbo, Vincent Blase, B.Ae.E.; Engineer, General Electric Co.

Covert, Eugene Edwards, B.Ae.E.; Asst. to Project Engineer, Naval Aircraft Modification Unit, U.S. Navy.

Durbahn, Dell Ames, B.Ae.E.; Jr. Engineer, Boeing Aircraft Co.

Goerke, Richard Frederick, B.Ae.E.; Ensign-Project Engineer, U.S. Naval Air Missile Test Center, U.S.N.R.

Hall, Albert Warren, B.S.; Aeronautical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Harkleroad, Edgar Lehman, B.S. in Ae.E.; Asst. Project Engineer, David Taylor Model Basin, Aeromechanics Div. (Washington, D.C.).

Hoffstedt, Donald John, B.Ae.E.; Layout Draftsman, Piper Aircraft Corp.

Holder, Leonard Irvin, B.S.; Asst. Prof. of Mathematics, North Texas Agricultural College.

Hope, Liu Kwang Ying, B.Sc. in Ae.E.; Coordination Engineer, Boeing Aircraft Co.

Morgan, Ralph Walter, B.S.; Vice-President, Morgan Motor Co., Inc.

Nakanishi, George, B.S.

Nash, William, B.S. in Ae.E.; Jr. Structural Engineer, Columbus Plant, Curtiss-Wright Corp.

O'Brien, William Daniel, B.S. in Ae.E.; Flight Test Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Pepper, William Burton, Jr., B.Ae.E.; Asst. Instructor of Engineering Drawing, University of Colorado.

Soderberg, Laurence Regua, B.Ae.E.; Instructor, Engineering Drawing Dept., University of Colorado.

Tuminello, Angelo Samuel, B.Sc.

Willner, Irving, B.Ae.E.; Jr. Aeronautical Engineer, Columbus Plant, Curtiss-Wright Corp.

Wunderman, Robert Lee, B.Ae.E.; Detail Engineer, Boeing Aircraft Co.

Zachary, John Thomas, B.S. in Ae.E.; Computer, University of Washington.

Necrology

William P. Redding

William P. Redding, who spent a lifetime promoting aviation, died at the Mayo Clinic in Rochester, Minn., February 17. Mr. Redding was perhaps best known for his work as Executive Secretary of the Interstate Airways Committee. He was Treasurer of the National Aeronautic Association from 1940 to 1942. At that time he was elected Executive Vice-President. Pressure of duties as Washington executive commissioner for the Denver Chamber of Commerce forced his resignation at the end of 1943. He then resumed the post of Treasurer, a position he held until July, 1946, and served as an able adviser to national headquarters in Washington until his death.

Mr. Redding was an Associate Member of the Institute.

I.A.S. National Meeting Schedule

Personal Aircraft Meeting—Detroit, Mich., Horace H. Rackham Educational Memorial—May 26–27, 1947

Annual Summer Meeting—Los Angeles, Calif., Ambassador Hotel—August 7–8, 1947

All correspondence should be addressed to The Meetings Committee, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

One President to another—Sir Frederick Handley Page, President, The Royal Aeronautical Society, is greeted by Preston R. Bassett, President, Institute of the Aeronautical Sciences, at an Institute dinner in honor of Sir Frederick at New York's Hotel Pierre, February 25, 1947.

Editorial

Hands Across the Sea—

One of the more encouraging and decidedly pleasant things about the piping times of peace we are now enjoying is the reappearance on these shores of many of our old friends from overseas. To be sure, some of them came and went during the war on urgent (and sometimes secret) missions. Then, too, some of us who were wandering about the world ourselves occasionally crossed their tracks. Now, however, we may really relax with them and enjoy the free interchange of ideas that marked the prewar days. Once again we may lean comfortably over our fences and swap yarns with our neighbors.

The Institute has always functioned on an international scale. Lester Gardner not only traveled widely himself but always saw to it that other I.A.S. members, when abroad, were properly introduced in whatever country they visited. On this side, Institute headquarters became the first port of call for foreign visitors.

During the past several months, a number of familiar and distinguished names have been added to the Institute Guest Book. Baron de la Grange and Prof. Kampe de Feriet arrived from France. Austin Wright and J. A. Wilson dropped in from the frozen north, and the growing British list included such old friends as N. E. Rowe, Peter Masefield, Sir Oliver Simmonds, and, most recently, Sir Frederick Handley Page.

"H-P's" visit was particularly gratifying. It gave an opportunity to many of his old friends to meet with him again. It also gave the opportunity to the Officers of the Institute to discuss with him, as current President of The Royal Aeronautical Society, plans for the renewal of contact with that society.

For some months preceding, discussions had been under way by correspondence with the R.Ae.S. on the possibility of a joint meeting this year. Sir Roy Fedden made the initial proposal early in the Spring of 1946, and your Director and Captain Pritchard have since been blowing on the spark. Subsequent discussions with Peter Masefield and Sir Oliver Simmonds started up a modest fire, but Sir Frederick's visit built up a full-scale blaze.

Preliminary plans are well along. Subject to changing conditions in a far from static world, the first week in September will be devoted to technical discussions between representative groups of the I.A.S. and R.Ae.S. The locale will be London. During the following week, American visitors will be given an opportunity to see something of Britain's postwar aviation progress. The annual static and flying displays of the Society of British Aircraft Constructors are scheduled for that period, and arrangements will be made for visits to factories and other centers of activity. Our prospective hosts of The Royal Aeronautical Society have assured us an interesting and worth-while program.

This is the beginning of what is hoped to be an era of close scientific collaboration with our colleagues overseas. Within 2 years following, at the most, a return visit will be arranged for the British on our side of the Atlantic. By such means the aeronautical sciences of both countries will advance more rapidly than by each going along alone.

Eventually, other aero-scientific bodies of other countries should be brought into the exchange program. How soon and how far we can go in that direction depends obviously on the attainment of a politically stable world. In that happy event, the scientific knowledge of all nations could be tossed into the common pot, and real progress in aviation would follow. The airplane would quickly take its place as one of the greatest instruments for ensuring international peace and understanding that the world has ever seen.

Meanwhile, awaiting the millenium, we believe that a better basis of understanding between aeronautical engineering people in Great Britain and America is a highly desirable thing, and we are looking forward to meeting with them shortly on their home grounds.

S.P.J.

A Guide to Aircraft Power-Plant Selection

ARTHUR L. LOWELL*
A.A.F. Air Matériel Command

SUMMARY

IN RECENT years, the practical methods of propulsion available to the aircraft designer have increased in number from one to five basic types, characterized by different features of construction, operation, and performance. The systems presently available are:

(1) *Reciprocating engine plus propeller:* As the classical "internal combustion engine," this type of power plant is the most highly developed aircraft propulsion system.

(2) *Rocket:* This is the fundamental "reaction" or "thermal jet" engine, deriving its thrust output from the momentum of gaseous products of combustion discharged.

(3) *Turbojet:* This thermal jet engine replaces the internally carried oxidizer of the rocket with atmospheric air, thus effecting a reduction in propellant weight that must be carried. This type of power plant is used in most current jet-propelled aircraft.

(4) *Ram-jet, athodyd, or compressorless thermal jet:* At sufficiently high speeds the air compression afforded by a diffuser alone is high enough to permit operation of a thermal jet engine without a compressor. A subtype of the ram-jet is found in the pulse jet or "intermittent ram-jet," as used initially in the German V-1.

(5) *Turboprop or gas turbine with propeller drive:* In the turboprop the turbine takes more heat energy from the combustion products than is required for the compressor, the excess being used to drive a conventional propeller. Of the net useful work produced by the engine, 80 per cent or more is delivered to the propeller, the remainder being realized by jet reaction as before.

There are, in general, three types of study which the designer may make as a guide to proper power-plant selection. They are listed below in decreasing order of accuracy as applied to a particular aircraft design but in increasing order of applicability to a variety of designs and requirements:

(1) Installation and performance studies of existing or projected engine models in a specific design or class of aircraft.

(2) Installation and performance studies of "scaled-up" or "scaled-down" versions of existing or projected engines in a specific design or class of aircraft.

(3) Comparison of the basic engine types themselves, selecting some common parameters of engine performance by which a general but quantitative picture of the suitability of each type to various kinds of duty may be surveyed. Airplane design parameters are not considered, and the resultant simplification makes it possible to present, for the designer, a first approximation to the power-plant selection sought without exhaustive computations on his part.

Received November 27, 1946.

* Captain, Wright Field.

The five basic power-plant types discussed under the first heading have been compared on a general but quantitative engine performance basis. The parameter and method of presentation used follow concepts developed by H. S. Tsien and M. Alperin, of the Scientific Advisory Group, Headquarters, Army Air Forces. In this approach, the total initial weight in power plant plus fuel—i.e., the total weight that must be budgeted to propulsion to supply a given thrust at a given cruising speed and altitude and for a given range—is computed and compared as the most significant engine performance factor. As a further generalization, this weight is reduced to a "Specific Propulsion Weight," i.e., the weight of power plant plus fuel required to deliver one pound of thrust under the conditions and for the range indicated. The present study covers a range of speeds from 0 to 700 m.p.h., at two altitudes: sea level and 30,000 ft. Such a general study requires the use of gross thrust, i.e., the total thrust of the power plants in the engine parameter selected. Although the use of net thrust—i.e., gross thrust minus cooling drag, where applicable, and certain items of external drag chargeable to the engine—would result in a more rigorous comparison, these drag items are highly dependent upon the particular aircraft installation that is made and cannot be separated from the overall aircraft drag picture. The difference in installation "cleanness" possible with the different power-plant types will appear in, and influence, the results of the final installation and performance studies noted above. However, as may be seen from the discussion and plotted results that follow, the differences in output and economy of the basic engine types under consideration are, in themselves, so large that relative engine cleanness may be discounted as a second-order effect without prejudicing the validity of the general conclusions drawn or reducing the usefulness of the selection guides presented.

Figs. 1 and 2 present estimated curves of power-plant weight and fuel consumption per pound of gross thrust versus true air speed for the rocket, ram-jet, turbojet, turboprop, and reciprocating engine. In these, as in the figures that follow, solid lines represent quantities applying to an operating altitude of sea level, while dashed lines represent quantities applying at 30,000 ft. The symbol *RE* represents the reciprocating engine, *TP* represents the turboprop, etc., for

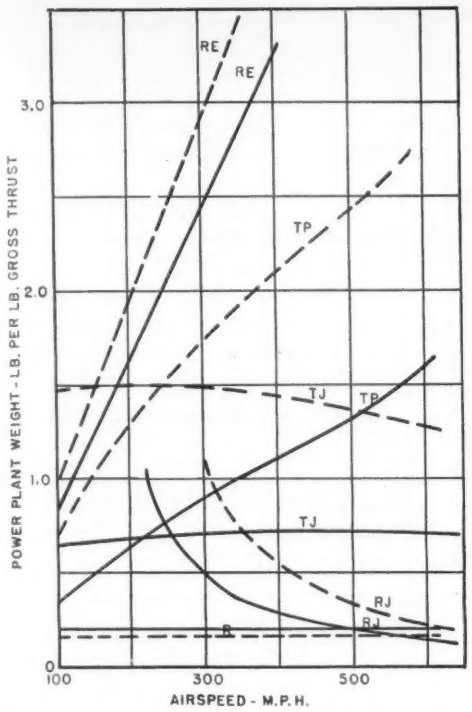


FIG. 1. Power-plant weight per pound gross thrust versus air speed.

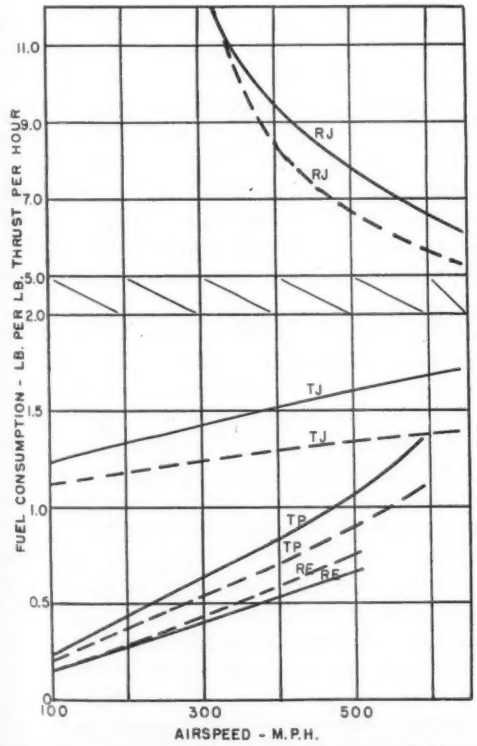


FIG. 2. Power-plant fuel consumption per pound gross thrust versus air speed.

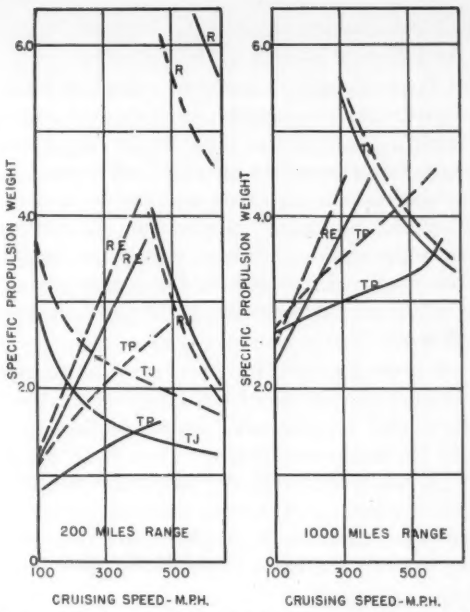


FIG. 3. Specific propulsion weight versus cruising speed; 200- and 1,000-mile range.

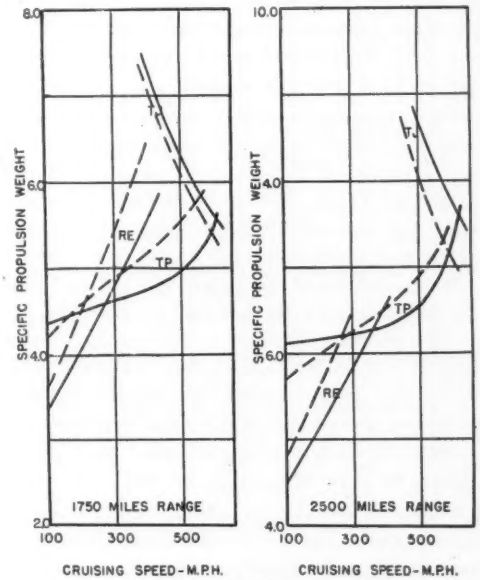


FIG. 4. Specific propulsion weight versus cruising speed; 1,750- and 2,500-mile range.

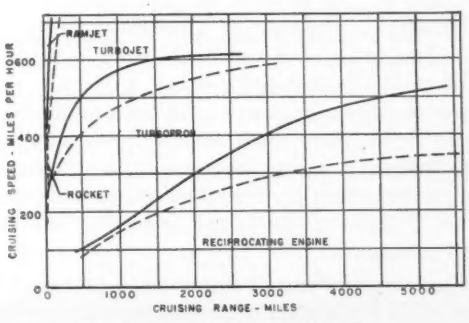


FIG. 5. Power-plant selection chart.

the turbojet, ram-jet, and rocket. It would be well to note the following features of the estimates:

(1) Data on engines existing or under development, or accepted theory representing performance currently attainable, are used as the basis for the computations. For all the types except the reciprocating engine, operation is assumed at maximum continuous thrust, the condition for minimum specific fuel consumption. For the reciprocating engine it is also assumed that operation is at minimum specific fuel consumption, but this is taken as corresponding to 60 per cent normal rated power.

(2) It is assumed that the power plants are designed for operation at each speed considered—i.e., that the propellers and compressors, where applicable, are designed for maximum efficiency at each air speed in turn. The low-speed values of power-plant weight and specific fuel consumption for the assumed turbojet and turboprop are, therefore, somewhat lower than corresponding values for existing engines of these types designed for high speed.

(3) Power-plant weight includes propellers, normal accessories, superchargers, and ducting and cooling items, where applicable, but does not include cowlings except where these are integral with the engine, as in the ram-jet. Fuel consumption includes an allowance of 5 per cent for fuel tank weight.

Curves of specific propulsion weight versus air speed were computed for a series of ranges from 15 to 4,500 miles. Examples of the resultant plots are shown in Figs. 3 and 4. These curves indicate the relative weight efficiencies of the various power-plant types under a wide variety of speed and range conditions. They also show the magnitude of the weight that must be budgeted to propulsion for each of the power-plant types under the operating conditions shown. In the latter connection, it should be remembered that the general nature of this study makes the specific propulsion weight figures quoted approximate and that they represent values currently attainable rather than performance figures for particular engine models.

The curves of specific propulsion weight were summarized to obtain Fig. 5. In this chart the five basic power-plant types are shown occupying zones of maximum weight efficiency on a graph whose ordinate is cruising speed and whose abscissa is range. This chart may be used to select the power-plant type that will require a minimum of propulsion weight for a given range, at a given speed, at the altitudes shown and at intermediate altitudes by interpolation. Again, caution is advised against applying the results too literally to specific aircraft designs. However, proper use of this chart should permit reducing the scope of more detailed power-plant studies, to satisfy any particular set of requirements, to not more than two of the basic types shown.

By referring to Fig. 1, it will be noted that the power plants under consideration have thrust per unit weight characteristics that show markedly different variations

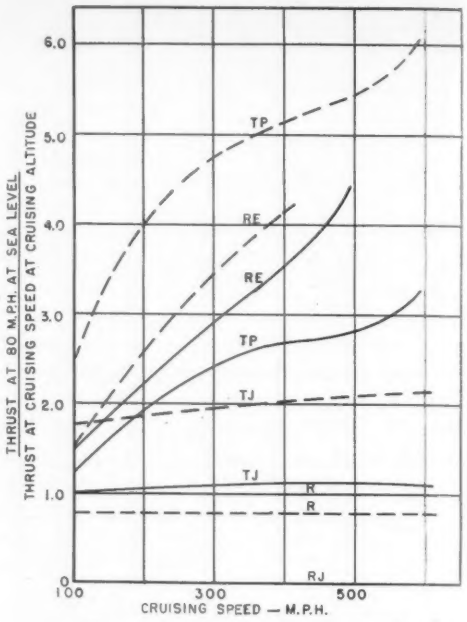


FIG. 6. Thrust capacity for take-off

with speed. The rocket shows no variation; the turbojet, very little. The reciprocating engine and the turboprop show a loss in thrust with speed increase, while the ram-jet has an increase in thrust with speed. Since these power plants must take themselves, their fuel, and their vehicles off the ground, the thrust they can deliver at low speed and low altitude is of extreme importance. If the thrust at cruising speed and altitude is the primary engine variable, then the ratio of thrust under take-off conditions to the thrust at cruising conditions is a measure of the relative take-off capabilities of the engines. Curves of such a take-off parameter are presented in Fig. 6. It is noted that the turboprop and reciprocating engine are substantially better than the turbojet and rocket, while the ram-jet is so poor that assisted take-off and climb will be required in any installation where this power plant is the sole prime mover.

The data presented in Figs. 1 through 6 do not lend themselves to design comparisons based upon high speed or rate of climb. For all power plants except the reciprocating engine, the assumption of cruising operation at maximum thrust leaves no excess thrust for short-duration flight at a higher speed. A high-speed requirement could only be taken into account by the addition of a stand-by power-plant weight that could not be evaluated without the assumption of a specific requirement relating high speed and cruising speed. Such an assumption would be inconsistent with the general nature of this study. However, since the reciprocating engine's specific propulsion weight was taken at 60 per cent normal rated power, it alone can be considered to include, without additional weight allowance, a source of extra thrust for high speed. This factor should be considered in using the figures.

Consistent with the assumptions noted in the preceding paragraphs, the following general conclusions may be drawn from these data regarding aircraft power-plant suitability for subsonic flight in the troposphere:

(1) The rocket is not an economical prime mover for aircraft, other than short-range missiles, in the above speed and altitude range.

(2) The subsonic ram-jet is economical only for ranges of the order of 200 miles or less. Assisted take-off and acceleration to operating speed will be required for this power plant.

(3) The turbojet is an economical aircraft prime mover at high speeds and low ranges. Comparatively low take-off thrust characteristics may require assisted take-off for overload conditions.

(4) The turboprop is the most economical power-plant type for moderate to long ranges at cruising speeds now considered appropriate for bombers and high-speed transports. Take-off thrust characteristics are good.

(5) At speeds corresponding to maximum efficiency for conventional air frames, the reciprocating engine is the most economical power plant. This power plant is most suitable, therefore, where transportation in terms of ton-miles is the primary requirement. As in the case of the turboprop, take-off thrust characteristics are good.

I.A.S. Meeting Preprints

A limited number of copies of preprints of papers presented at meetings of the Institute are available for distribution, at a charge of 25 cents each to members of the Institute, and 75 cents to nonmembers, to cover handling and mailing charges. The following lists the preprints available from the past three national meetings of the Institute. Preprints may be ordered by number.

Light Aircraft Meeting—Detroit, Mich., June 13–14, 1946

18. Maintenance of Personal Aircraft—George H. Weitz, Chief, Air Frame Section, Non-Scheduled Aircraft Maintenance Division, Civil Aeronautics Administration. 7 pages; no illus. (Mimeographed.)

National Air Transport Meeting—Washington, D.C., October 24, 1946

27. Development of International Standards for Airworthiness of Transport Aircraft—Paul A. Puvrez, Expert, Airworthiness Division, Provisional International Civil Aviation Organization (PICAO). 9 pages; no illus. (Photo-offset.)

28. Air Conditioning of Transport Aircraft for Year Around Comfort in Flight and on the Ground—Bruce E. Del Mar, Mechanical Test Engineer, Santa Monica Engineering Division, Douglas Aircraft Company, Inc. 10 pages; 10 illus. (Photo-offset.)

29. Teleran for Air Navigation and Traffic Control—L. F. Jones, Manager, Research & Development Projects, Radio Corporation of America. 24 pages, bound in covers; 17 illus. (Printed.)

30. Survey of Air Rescue Requirements—Jerome Lederer, Chief Engineer, Aero Insurance Underwriters. 31 pages; 4 illus. (Photo-offset.)

Fifteenth Annual Meeting—New York, N.Y., January 28–30, 1947

31. Critical Speeds of Shafts Under Torque—R. M. Rosenberg, Instructor, School of Aeronautics, Purdue University. 34 pages; 8 illus. (Ditto.)

32. Numerical Methods for the Calculation of Elastic Instability—B. A. Boley, Instructor, Department of Aeronautical Engineering and Applied Mechanics, Polytechnic Institute of Brooklyn. 38 pages; 6 illus. (Mimeographed.)

33. C.A.A. Testing of Helicopters—R. B. Lightfoot, Chief of Flight Research, Sikorsky Aircraft Division, United Aircraft Corporation. 23 pages; 6 illus. (Ditto.)

34. Progress in Dynamic Stability and Control Research—W. F. Milliken, Jr., Flight Research Department, Cornell Aeronautical Laboratory. 89 pages; 19 illus. (Ditto.)

36. A Method for Calculating Airfoil Sections from Specifications on the Pressure Distributions—Glenn L. Peebles, Design Analyst, Douglas Aircraft Company, Inc. 18 pages; 6 illus. (Ozalid.)

38. Pressure Measurements from V-2 Rockets—Nolan R. Best, Naval Research Laboratory. 10 pages; 7 illus. (Mimeographed.)

40. High-Speed Underwing Fueling—Eric Olsen, Manager, Aviation Division, The Wayne Pump Company. 8 pages; no illus. (Mimeographed.)

41. Transport Problems with Turbine Power Plants—Frank W. Kolk, Supervisor, Design and Performance, American Airlines, Inc. 10 pages; no illus. (Mimeographed.)

The Application of Microwaves to Instrument Landing of Airplanes*

JOSEPH LYMAN†

Sperry Gyroscope Company, Inc.

SUMMARY

AVIATION as a means of transportation is still unreliable. The reason for this is bad weather.

The precise navigational requirements and attempted solutions for landing aircraft under restricted visibility conditions are discussed in this paper. Although solutions to a number of important requirements are not yet answered they are at least understood at the present time. The information presented can well serve as a guide to eventual solution of this important but complex problem, including both manual landings using instruments and landings made by an automatic pilot.

It is concluded that continuous-wave (c-w) microwave radio technique offers the most useful tool for the precise guidance of aircraft to a stipulated point of contact on a runway. For, with the advent of microwave frequencies, it became possible to design and construct a system using radio beams shaped as the engineer and pilot desired them.

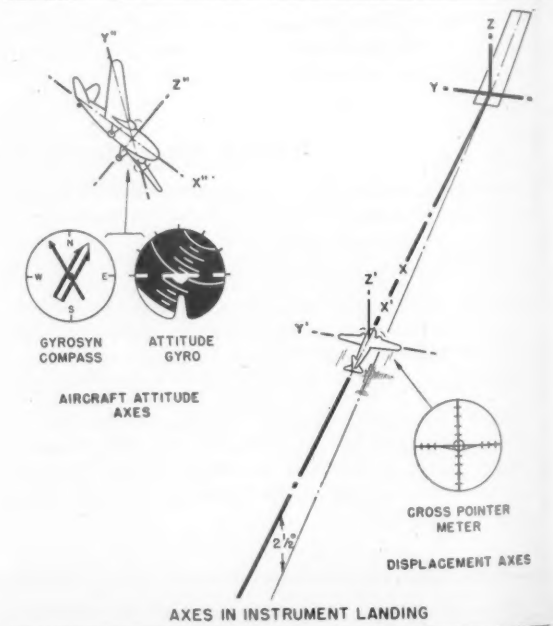
What are the actual requirements of a landing system from the pilotage and operational point of view? The answer to this question is prefaced by a review of the following attempted solutions.

The earliest work was the development of fixed guiding beams or planes in space. While this did not provide operational instrument landing facilities, it did lead to the establishment of the A-N keyed radio-range system. In early research, low radio frequencies of 200 to 400 kc. were employed, resulting in reflected beams and distortion. This prompted experiments with a gradual increase in frequency to 100 mc. (10 cm.).

Other systems of landing aids were tested. Lighting equipment and fog dispersal systems did not provide guiding coordinates for aircraft control. Radar has two major deficiencies: it requires the use of a cathode-ray tube for presentation, and it does not lend itself readily to automatic operation for multiple aircraft.

Some general requirements for landing and control of multiple aircraft are as follows: (a) Three axes, all of which are referred to the earth and specifically some part of the airport, must be established. The pilot, either human or automatic, must be kept informed of

his position and attitude with respect to these axes (see illus.). Presentation to the human pilot must be so natural and obvious that no unusual evaluation procedure or training problem is involved. The system should be applicable to automatic flight equipment. Information must be available for both manual and automatic flight at all times for emergencies. Axes



AXES IN INSTRUMENT LANDING

* Preprints of complete paper (presented at the National Air Transport Meeting, I.A.S., Washington, D.C., October 24, 1946) are available from Sperry Gyroscope Company, Inc., Great Neck, L.I., N.Y.

† Research Engineer.

must be established with a fixity in space and with an accuracy far greater than any requirements considered adequate in the past.

(b) The system must be a public use system, able to function unmanned and available to any properly equipped aircraft at any time of the day or night. There must be some means for automatically monitoring the system for accuracy.

(c) It must be capable of handling as great or greater traffic density under instrument flight conditions as would normally be handled under good visibility conditions. This calls for a minimum of ground-to-air radio conversation.

(d) The path in space, no matter how it is generated, must have no perceptible bends or kinks. The airplane must be properly located in space and oriented as to heading and pitch attitude at any given instant.

(e) The path should be clean, sharp, and precise down to the ground.

(f) The system must be completely reliable, free of all types of radio interference and transmission irregularities, and independent of weather and ground conditions.

More work and development effort has been spent on the production of a fixed-beam system than on any other arrangement. To avoid the phenomenon of unwanted reflections, the trend has been to increase the radio frequency still higher as radio-frequency vacuum tubes and techniques developed. This permitted more precise control of the radio beams.

In the application of microwaves to the instrument landing problem, pulse radar technique restricted the allowable type of modulation to short bursts of energy. This restriction thereby made continuous sine-wave modulation difficult, thus precluding the later integration of airport traffic control and air navigation devices with the landing system.

It was decided to concentrate on the development of the necessary means for continuous wave transmission and reception so that the basic tools used would themselves impose no limitations to progress. As a result, direct crystal frequency stabilization in the microwave region is now closely approaching the stability available in the broadcast band and the whole c-w technique is well advanced.

The development of c-w microwave technique permits fullest radio-frequency spectrum utilization. Increased utilization is accomplished through narrow-band technique made possible for two reasons: (1) frequency stability and (2) the simple character of the intelligence transmitted which requires only narrow-band transmission.

A definite portion of the microwave spectrum had to be chosen. It was found that the higher radio frequencies (25,000 mc.) were greatly attenuated under certain atmospheric conditions, principally high moisture content. The lower frequencies suffered less from natural disturbances. On the other hand, since radiator size is inversely proportional to frequency, reasonable antenna sizes demanded the highest possible radio frequencies. An engineering compromise had to be made.

There is a tremendous difference between direct transmission of radio energy and reflection transmission. In the first case, attenuation of the signal is proportional to the square of the distance. In the second case, attenuation is proportional to the fourth power of the distance. Using direct transmission at angles above 0.5°, interference or distortion of the guiding lines in space has never been encountered, nor is it likely to occur, at 3,000 mc.

For these reasons and because of the availability of the necessary vacuum tubes for c-w operation at this frequency, the development work described was started at 3,000 mc. If it is necessary to increase beam sharpness further, a higher frequency—5,000 mc.—is recommended. Antennas for this frequency are of reasonable dimensions and are suitable for most conceivable applications.

The general requirements of such a fixed-beam landing system are broken down into three parts.

(*1*) *Azimuth Guidance:* The basic tools of any fixed-beam system are two guiding planes established from the airport, the intersection of which determines the proper line of flight for contact with the runway at the desired point. Azimuthal guiding is accomplished by a radiating system known as the localizer. The localizer, within its limitations, establishes a vertical plane with some region on either side being indicated by a proportional signal in the aircraft.

Most fixed-ground localizer stations give a localizer flight path that is approximately ±3° for full signal left to full signal right. Any attempt to make a localizer station provide wide angular coverage and still maintain suitable precision for guidance to a narrow runway results in a compromise. The first requirement is stability and precision of the guiding plane. Once this has been achieved, omnidirectional guidance may be added as a separate system and properly integrated into one means of azimuthal guidance for multiple aircraft.

(*2*) *Glide Angle Guidance:* There are two conflicting requirements: (a) that the glide path to point a ground contact must have high definition and (b) that proportional indication must be secured through a comparatively large vertical angle.

(*3*) *Distance Indication:* Most developmental activity along this line has been based on the use of markers that indicate, at specific points along the approach path, the exact distance from the center of the system. Markers suffer from the defect of providing discontinuous distance fixes. Radar technique suffers from problems of securing accurate information at extremely short ranges.

Another form of distance measuring technique is now under development making use of c-w microwave signals employing techniques similar to those already discussed.

(*Continued on page 69*)

I.A.S. Briefs

Summaries of current papers received for publication or presentation at I. A. S. meetings

The Rate of Descent of Parachutes from Various Altitudes

By

Kenneth E. Penrod, George L. Maison, and James E. McDonald

Boston University and Iowa State College

One hundred and eleven observations were made on the descent times of 200-lb. torso dummies attached to 28-ft. silk, 28-ft. nylon, and 24-ft. nylon parachutes. These observations were made from various launching altitudes up to 40,000 ft. A C_DS value was computed for each descent from the formula $C_DS = 2W/\rho V^2$, where W = weight of the dummy plus parachute and ρV^2 was calculated from the observed atmospheric conditions. The mean C_DS values thus computed were: for 28-ft. silk parachutes, 531; for 28-ft. nylon, 483; and for 24-ft. nylon, 336.

Using the mean C_DS value computed for each type of parachute, a formula has been developed to predict the time of descent from any altitude to any altitude if the type parachute, weight of the man, and certain atmospheric conditions are known.

An improved method of comparing performance of experimental parachutes is presented which negates the necessity for attempting to duplicate a given density altitude on successive flights.

A method is presented for calculating velocity at any instant in parachute descent. Landing velocities at different ground levels and with different types of parachutes and different weight men are discussed.

Tensor Analysis of Aircraft Structural Vibration

By

Charles E. Mack, Jr.

Grumman Aircraft Engineering Corporation

An application of elementary tensor principles to the problem of determining airplane vibration modes and frequencies is presented. Emphasis is placed upon the fact that the method, which results in equations comparable in form to those of previous matrix iteration procedures, is readily applicable to the vibration of an airplane as a unit. Heretofore, it has been customary to analyze wing, fuselage, and tail vibrations separately.

The analysis given presupposes that the vibration characteristics of the continuous structure may be approximated by a system with a finite number of degrees of freedom. It is shown that for the type of problem considered, in which there may be as many as six ignorable coordinates corresponding to the six possible degrees of freedom of the system as a rigid body, the equations are obtained in a simple form if two sets of generalized coordinates are used, one for the kinetic and the other for the potential energy. Knowing the relation between these sets of coordinates, the rigid body modes are eliminated in such a manner that the resulting equations are especially suitable for the computation of the higher modes.

The derivation of the kinetic and potential energies of the airplane as a whole and the relation between the two sets of coordinates are carried out in a manner essentially equivalent to that used by Kron for electrical systems and by Hoffmann for mechanical systems. The structure to be analyzed is divided into two or more subsystems, in each of which the energies and relations between the coordinate sets are known. Then the corresponding quantities of the original structure are obtained from those of the subsystems by a straightforward procedure, which is intrinsically independent of any particular problem. Two cases are considered in some detail, the first of which involves arbitrary coordinates of the subsystems.

The determination of the higher modes is briefly discussed, and, apart from the main body of the paper, the effect of the

This Section, started in the January, 1947, issue of the REVIEW, *has been established to give advance and current information on papers presented to the Institute for publication or for presentation at meetings. Summaries of all pertinent papers, including those given at Section and Student Branch meetings, will be published each month in these columns as rapidly as they are received from authors.*

Many of these papers, after being processed by the Editorial Committee in the usual manner, will appear in full in later issues of the JOURNAL *or* REVIEW. *Preprints of some papers are immediately available, or will become available at an early date, at a price of 25 cents each (to cover handling costs) to I.A.S. members, and 75 cents each to nonmembers. Requests for preprints should be addressed to Editorial Department, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.*

rotary inertia on certain bending vibrations is investigated. With a view to practical applications, the general theory is illustrated by three specimen examples written in matrix form.

An attempt is made in this paper to focus attention upon certain features of the method of approach not discussed by Kron or Hoffman. The analysis, though developed with special reference to airplane vibrations, is sufficiently general to apply to a wide range of problems involving ignorable coordinates.

The Problem of Escape from the Earth by Rocket

By

Martin Summerfield and F. J. Malina

California Institute of Technology

The problem of imparting to a given pay load the necessary velocity to escape from the earth is re-examined in the light of recently released information on wartime rockets. The fundamental equations of motion of a rocket in outward radial flight are derived, and the influence of each of the following design parameters is examined: c, the effective jet velocity; ζ, the ratio of propellant mass to initial mass; t_p, the time of powered flight; μ, the ratio of initial mass to maximum cross-sectional area; and C_D the drag coefficient based on the same cross-sectional area.

The exhaust velocities attainable with rocket propellants range between 6,200 ft. per sec. for nitric acid-aniline and 10,200 ft. per sec. for oxygen-hydrogen, the former being representative of dense propellants and the latter of light propellants. On the basis of the design characteristics of the V-2 rocket, it is believed that the maximum practical value of ζ that can be realized is about 0.8. Therefore it is concluded that single-step rockets utilizing propellants that develop their energy by chemical reaction cannot escape from the earth. Escape may be accomplished by single-step rockets, however, if nuclear sources of energy can be used to heat gases of low molecular weight in order to provide much higher exhaust velocities.

The analysis is extended to calculate the velocity achieved by a multiple-step rocket. The overall mass of the rocket and the maximum velocity of the last step are related to the number of steps and to the ratio of the masses of successive steps.

It is shown that the necessary velocity can be attained with any of the rocket propellants available by proper choice of the number of steps. Various examples of multiple-step rockets capable of projecting instrumental pay loads away from the earth are presented.

A New Method for the Aerodynamic Design of Multistage Axial Flow Compressors*

By

Hunt Davis

Elliott Company

This paper describes the derivation of an optimum inlet Mach Number for the first stages of an axial flow compressor. The optimum Mach Number is related to the given inlet conditions, dimensions, and tip speed and specifies the maximum amount of work that can be done on the fluid and the corresponding velocity diagrams at any radius in a stage where Mach Number effects are critical.

A graphical method is described for simplifying the construction of velocity triangles for points along a radius. It is shown that it is possible to design successive stages using the same rotor blading and the same stator blading by merely changing the spacing and root stagger angle, although the velocity diagrams at every radius may change markedly from one stage to the next. This method does not necessitate a violation of the laws of potential flow.

* Presented at National Aircraft Propulsion Meeting, I.A.S., Cleveland, March 28, 1947.

DC-6 Conforms to New Fire-Prevention Regulations

By

I. J. Hammill

Walter Kidde & Co., Inc.

The fire-protection equipment designed for the Douglas DC-6 incorporates two systems to protect eleven areas of possible fire hazard. The main system is mechanically operated to deliver carbon dioxide to the engine nacelles, the cargo compartments, and the fuselage accessory compartment. It has cable controls and consists basically of two banks of carbon-dioxide cylinders mounted in the nose-wheel well, each bank of three 15-lb. bottles being connected by piping and selector valves to discharge rings and nozzles in the hazard areas where detectors are located. The second system is electrically operated and provides protection for the heaters for the cabin, as well as the wing and tail anti-icing systems, by means of controls that shut off the main and emergency heater-fuel systems and discharge the fire-smothering gas. Thermocouple-type automatic fire detectors operate upon any dangerous temperature rise in the engine nacelles and combustion heaters, while Kidde smoke detectors function by means of photoelectric cells in the cargo and accessories compartments to activate the alarm signals.

Numerical Procedures for Calculation of Stress Distribution in Sheet-Stringer-Frame Combinations

By

Marvin Stern

Republic Aviation Corporation

Stress distribution problems encountered in the homogeneous isotropic material that comprises the pure monocoque structure can usually be resolved by straightforward applications of the mathematical theory of elasticity. However, when these same problems arise in the sheet-stringer and frame combinations of the semimonocoque aircraft structure, their solutions become much more difficult.

Standard rational methods for performing such shear lag calculations have been found to be too involved and time-consuming for practical design purposes. The method described in this paper combines theory of elasticity with a technique of successive approximations. The method can be employed by calculators with little previous training and converges rapidly to an exact solution.

The same differential equations are developed here as appear in available literature on this problem. These equations are then solved by use of the method of finite differences. As a result the sheet-stringer problem is conveniently reduced to an analogous homogeneous or thick sheet problem.

This method proves to be convenient when the problem involves sheet doublers, varying stringer thicknesses, and tapered panels.

In this paper the simple case of "One-Directional Shear Lag" is illustrated. Although the more involved shear lag problems are handled in a similar manner, they have not been treated in this article.

The Future Role of Rapid Computing in Meteorology

By

John von Neumann

Princeton University

There are several factors that limit the possibility of meteorological prediction by exact, reproducible methods; viz.: (1) We are not completely informed about the natural factors that govern meteorological phenomena. (2) Even if we knew these factors, the equations that would then express their operation would certainly turn out to be quite complicated, and altogether unmanageable by present analytical methods. (3) Even if we knew how to solve these equations, it is questionable whether our present observations are extensive and precise enough to furnish us with the necessary input data to start the integration processes that are required.

In assessing these limitations, the following comments seem appropriate:

(1) We are certainly not adequately informed about all natural factors that influence the physics of the atmosphere. However, there is reason to believe that we are, at least for short-range forecasting, sufficiently well-informed about the major influences. There is reason to believe that if we could do full mathematical justice to what we already know physically, we could come to a considerably more reliable system of forecasting than that which we possess today.

(2) There is no significant difficulty in setting up the system of equations that correspond to a simplified view of the physics of the atmosphere as indicated in (1) above. These equations turn out to be partial differential equations (possibly combined with certain integral equations), occurring in several parallel alternating schemes, the alternation being controlled by various inequalities. These systems are considerably beyond anything that we can hope to handle with the methods of analysis that exist today or that we can hope for in a not-too-distant future. On the other hand, they seem to be perfectly amenable to numerical calculation; provided that the numerical calculation is about 100,000 times faster than it is today by "manual" methods. Modern electronic, automatic computing promises to furnish this extra speed in the course of the next few years.

(3) Whether present observations, or observations that could be realized with new techniques in the next few years, are at all adequate as inputs to the calculations suggested in (2), can only be decided after the calculating facilities postulated there have become available and put to use.

There appears to be reason to believe that the necessary observational material could be obtained if a serious effort were made in that direction. Using it would certainly require mathematical smoothing and interpolation techniques that are not now in use in the field of meteorology.

Electronic computers now under development promise to give the extra speeds referred to above and could probably make it possible to perform the work necessary for a 24-hour global forecasting in a few hours. This should be enough to establish the appropriateness of such procedures. For really rapid forecasting in hypothetic situations, that is, for mathematical experimentation in the sense to be discussed by Dr. Zworykin in his address that follows, still higher speeds would be desirable. The electronic machines referred to above are likely to be of a mathematical "all-purpose" character that is not devised for meteorology in particular but rather for the average situations of other applications in the physical sciences. They will also probably be entirely digital, that is, use purely arithmetical techniques; and not attempt to obtain rapid solutions by the use of analogy methods, that is, of small scale models of certain special phases of the physics of the atmosphere. Special, specifically meteorological, electronic machines should be developed thereafter. These machines should be conceived as combining in an appropriate manner digital (that is, arithmetical) and analogy (that is, small scale model) components, these two types of components to be used under automatic control and alternating for various phases of the total problem as they are best suited. In comparing these two types of devices—"all-purpose" and digital vs. specifically meteorological and mixed digital and analogy, it seems reasonable to proceed with the first type first. The first type should be used to demonstrate the possibility of the procedures that were discussed above. The development of the second type should be undertaken next. The motivation for this procedure is clear: The first-type machines are simpler and their development can be amply justified by the use in other fields of science as well. Such developments are now under way in several organizations.

Aviation Gas Turbine Fuels*

By

W. J. Sweeney, A. J. Blackwood, and W. R. F. Guyer

Standard Oil Development Company

This paper discusses in broad terms the effect of individual specification items on both the performance and availability of aviation gas turbine fuels. The U.S. availability of fuels meeting the current kerosene type AN-F-32 and AN-F-34 specifications is compared with the national requirements that would prevail under both peacetime and emergency conditions. It is pointed out that, although supplying peacetime requirements would not be extremely critical, in the case of an emergency there would be a shortage of jet fuels. Accordingly, a detailed examination is made of the significance of individual specification items (e.g., freezing point, aromatic content, viscosity, and volatility) with regard to factors such as combustion performance, storage and handling, economy of operation, safety characteristics, and supply. The two alternate types of fuel specifications that are presently under consideration by the N.A.C.A. are described in detail. It is concluded that the prototype fuels should be evaluated both in the laboratory and in the field, since the potential availability of these is much more favorable, equaling or exceeding emergency demands.

* Paper presented at National Aircraft Propulsion Meeting, I.A.S., Cleveland, March 28, 1947, by A. J. Blackwood.

N.A.C.A. Cascade Data for the Blade Design of High-Performance Axial-Flow Compressors*

By

S. M. Bogdonoff

Princeton University

Low-speed and high-speed two-dimensional cascade tunnels and a low-speed test blower were used to determine an experimental method of designing high-performance axial-flow compressor blading. The investigation showed that the important parameters involved in compressor design, turning angle or loading, design angle of attack, and qualitative critical speed can be evaluated in these apparatus. Tests of this type give the much needed "limiting conditions" which dic-

tate the highest pressure ratio or power input that can be obtained in a single stage of a compressor. With the loadings and Mach Numbers shown possible by these tests, performance comparable to the best existing axial-flow compressor could be obtained with approximately half the number of stages now used.

* Presented at National Aircraft Propulsion Meeting, I.A.S., Cleveland, March 28, 1947.

Regenerative Rocket Cooling*

By

Thomas F. Reinhardt

Bell Aircraft Corporation

Regenerative cooling of a liquid propellant rocket is accomplished by flowing one of the liquid propellants through an annular jacket surrounding the combustion chamber and nozzle. The liquid cools the wall to a safe operating temperature, and the heat absorbed by the liquid is returned to the combustion chamber. A theoretical method is presented for calculating the cooling requirements of the rocket wall, the liquid velocities required to obtain this cooling, and the pressure loss in the cooling jacket resulting from the liquid velocities. Estimates of the heat transfer coefficients on the gas and liquid sides of the wall are given for the alcohol-liquid oxygen propellant system. Sample calculations are presented for a hypothetical 10,000-lb. thrust rocket.

* Presented at National Aircraft Propulsion Meeting, I.A.S., Cleveland, March 28, 1947.

Liquid Springs for Aircraft

By

Arthur E. Bingham

Dowty Equipment Limited

Work on the compressibility of liquids has been in progress for several centuries, and pressures as high as 45,000 lbs. per sq.in. were attained by Amagat, the first investigator to undertake serious research in the subject, in 1893. The possibility of using the compressive properties of liquids as a spring and of using the same volume of liquid as the dashpot medium occurred to George Dowty in 1938, and the first British patent covering the system was granted in 1939. Early experiments with a metal cylinder and plunger developed pressure of about 100,000 lbs. per sq.in., but the stress led to seizure of the working parts and distortion of the cylinder and trouble was experienced with the packing glands, resulting in leaks. Two discs of wire gauze between the gland and the inner washer solved the problems of gland-nut seizure and inner-washer distortion. By using high-tensile steel for the cylinder, a thin, light, and efficient construction was obtained, suitable for practical working pressures up to 50,000 lbs. per sq.in. A gland that will not leak at high pressure and will withstand friction throughout a reasonable service life was developed on the principle of the unsupported area, and this has given satisfactory results. Extensive research and test work established figures and curves for the apparent and absolute compressibility of various liquids, to be used as the hydraulic medium, and of various cylinder and gland materials. Curves were also established for the effects of temperature. The application of the principles of the liquid spring to the construction of an aircraft shock-absorber or landing-gear mechanism is explained, with details of the dashpot action and the operation of the valves for controlling the recoil. Applications of liquid springs to various British airplanes are outlined, ranging from the Gloster Gladiator in 1939 to the Bristol Brabazon now under construction. A table lists the properties of steels for cylinders and pistons.

Aero-Thermodynamic Study of Ram-Jet Propulsion

By

Boleslaw Szczeniowski

École Polytechnique (University of Montreal)

The artificial compression prior to combustion being absent in the ram-jet propulsion, while the condition that pressures at the front and at the rear are the same remains valid here, just as in any other system, the only factors that may influence the increase in momentum—i.e., the thrust—are:

(1) The rate of a prior dynamic compression by a diffuser.
(2) The shape of the combustion chamber.
(3) The variations of the rate of heat release along the tube.

The influence of these three factors is studied in the present paper, mainly in the theoretical case of an ideal gas with no hydraulic or heat losses involved.

In Section 2 the general theory of gas flow through a duct of variable cross section with heat release is given. The differential equations thus obtained are solvable only in special cases, as studied in the following sections.

Section 3 is devoted to the special case of a tube of constant cross section, while in Section 4 the problem of the ram-jet engine is discussed on the basis of entropy diagram.

Section 5 deals with thrust and efficiencies of the "perfect ram-jet engine"—i.e., the theoretical case of an ideal gas with no heat or other losses involved.

In Sections 6 and 7 an approach to the actual conditions is given. Section 8 is devoted to the actual jet engine.

Investigations set forth in Section 4 lead to the definition of the best shape of engine perfect from the point of view of efficiency. It is found that the air should be submitted to a prior dynamic compression, as high as possible—i.e., using all kinetic energy available—next comes the burner of a constant cross section and, finally, the nozzle for expanding gas down to the atmospheric pressure.

Another conclusion reached in Section 4 is that, whatever the efficiency, it is impossible to obtain a positive thrust with a burner of constant cross section if no prior dynamic compression by a diffuser is applied.

Numerical results as obtained in Sections 7 and 8 show once more that the simple ram-jet engine is rather a supersonic flight speed unit, providing relatively poor efficiencies at subsonic speed.

Instability Analysis and Design of an Efficiently Tapered Plate Under Compressive Loading

By

Samuel Pines and George Gerard

Republic Aviation Corporation

Use of heavy tapered skins is desirable to meet efficiently the load-carrying requirements of high-speed thin-wing aircraft. In addition, these skins must be nonbuckling from aerodynamic considerations. Consequently, the design of a nonbuckling tapered plate acting under various compressive loadings is considered.

Conditions for optimum taper are determined and the compression instability coefficient for a rectangular tapered plate of any aspect ratio is obtained. Design of the plate is then considered for both the elastic case and one in which a region is operating at critical stresses above the proportional limit.

Photo courtesy American Airlines, Inc.

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Aeronautical Reviews

Aerodynamics

Some Ballistic Contributions to Aerodynamics. A. C. Charters. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 155–166, figs. 11 references.

A systematic study of projectile aerodynamics has been made in the spark photography range of the Army Ordnance Department Ballistic Research Laboratory, and the results on drag are now sufficiently complete to have general application to compressible flow problems. Enough research has been completed to permit the formulation of empiric laws for (1) the variation of drag coefficient with Mach Number ($M > 1$), (2) the effect of boattail length on the drag, and (3) the effect of banding on drag. These laws, combined with theoretic calculations for head pressure and skin friction, are used to compute the drag of certain simple types of projectiles at supersonic velocities. The results of these ballistic investigations, and related theory as needed, are applied to the design of an aircraft fuselage giving the minimum supersonic drag.

An Application of IBM Machines to the Solution of the Flutter Determinant. E. L. Leppert, Jr. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 171–174, fig. 5 references.

An electrical "punch card" procedure for the formation and the solution of the complex flutter determinant has been developed, using an adaptation of W. M. Bleakney's trial-and-error method. The procedure is of particular value in obtaining answers for a complicated problem in a minimum of elapsed time and greatly reduces the possibility of human errors caused by fatigue and strain. The effects of variation of parameters are readily obtained. Amplitude ratios may be calculated with a small number of additional operations.

Aerodynamic Center and Center of Pressure of an Airfoil at Supersonic Speeds. H. W. Sibert. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 183, 184, figs.

Simple formulas (based upon the Ackeret theory for supersonic flow) are presented for obtaining the aerodynamic center and center of pressure of both symmetric and cambered airfoils.

Calculation of Surface Temperatures in Steady Supersonic Flight. George P. Wood. *U.S., N.A.C.A., Technical Note No. 1114*, December, 1946. 31 pp., figs. 16 references.

Calculations were made at Mach Numbers from 2 to 10 and for altitudes from 50,000 to 200,000 ft. and emissivities from 0 to 1. It was found, under the assumption of an isothermal atmosphere, that the gain of heat from the air by convection decreases at constant Mach Number as the altitude is increased. Equilibrium between convection and radiation is established at temperatures that consequently decrease as altitude is increased. In general, therefore, at sufficiently high altitudes the surface temperature is considerably less than the stagnation temperature. At a Mach Number of 8, for example, the stagnation temperature is 4,800°F. absolute and the equilibrium surface temperature for an emissivity of 0.5 is 3,800°F. absolute at 50,000 ft. and decreases to 1,350°F. absolute at 200,000 ft.

Charts for Determining the Characteristics of Sharp-Nose Airfoils in Two-Dimensional Flow at Supersonic Speeds. H. Reese Ivey, George W. Stickle, and Alberta Schuettler. *U.S., N.A.C.A., Technical Note No. 1143*, January, 1947. 37 pp., figs., tables. 6 references.

Solutions of the Hugoniot shock equations and Meyer expansion equations are plotted in such a manner as to permit the pressure distribution, the local Mach Number, and the angles of shock waves on arbitrary sharp-nose airfoils at supersonic speeds to be obtained directly.

Notes on the Theoretical Characteristics of Two-Dimensional Supersonic Airfoils. H. Reese Ivey. *U.S., N.A.C.A., Technical Note No. 1179*, January, 1947. 23 pp., figs. 7 references.

The shock expansion method described in *N.A.C.A. Technical Note No. 1143* (*see* preceding abstract), was used to determine the principal aerodynamic characteristics of two-dimensional supersonic airfoils, including the effects of thickness ratio, free-stream Mach Number, angle of attack, camber, thickness distribution, and aileron deflection. The calculations indicated that the minimum drag of supersonic airfoils is obtained when the maximum thickness is behind the 0.50 chord. The center of pressure obtained for a symmetric supersonic airfoil was found to be ahead of the 0.50 chord. Other conclusions are that the addition of a constant skin-friction drag coefficient results in a decrease in the lift-drag ratio with increasing Mach Number; for double-wedge airfoils the optimum position of maximum thickness is near the trailing edge at extremely high Mach Numbers and approaches midchord as the speed is decreased toward a Mach Number of unity; the aileron effectiveness factor is lower when estimated by the shock-expansion method than by the Ackeret method; and that the present method is a considerably closer approximation than Ackeret's method.

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Shock Stalled Flows for Supersonic Type Airfoils at Transonic Speeds. John Stack. *Paper Presented at Sixth International Congress for Applied Mechanics*, Paris, September 22–29, 1946. 19 pp., illus. 6 references.

Results of investigations of transonic flows for conventional airfoils define the character of the transonic flows for supersonic-type airfoils only in first approximation. The change of leading-edge shape from rounded to sharp appears to introduce a new phenomenon at the leading edge which, in some respects, is similar to the Prandtl-Meyer corner flow for completely supersonic flow fields. It appears that supersonic aircraft using supersonic-type airfoils may experience less difficulty in passing through transonic regions than had been expected, because the flow separation about the leading edge found at low speeds for the supersonic-type profiles is eliminated. The efficiencies of high tip-speed propellers may be improved through incorporation of the sharp-edge profile for elements of the blade in the shock-stalled region.

The Nature of Shock Waves. Max M. Munk. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 66, 67, 137–139, illus.

Shock waves are defined as the mechanism by means of which the air obtains that swiftness of reaction and that massiveness needed to pass by a fast-flying object, and which is denied to it in other regions. Without shock waves the air moves with little friction and heat flow, but compressible air does change its density in definite relation to the pressure, whereby points of equal density are also points of equal pressure. The definite velocity of sound is a consequence of this fixed interrelation of density and pressure. How friction can increase the velocity of pressure propagation is explained, showing how that velocity is necessary to hold the shock wave together. The question of massiveness has to do with what occurs along the sides of a missile flying at supersonic speeds. Shock waves make it possible for air to flow supersonically around missiles, but they give rise to drag and aerodynamic losses that must be taken into account in designing aircraft and wind tunnels. A comparison is made of the shock-wave flow with the flow of water in shallow streams where a "water jump" is formed.

Transonic Hazards Reduced. John Stack. *Aviation*, Vol. 46, No. 2, February, 1947, pp. 43–45, figs. 6 references. (Extended abstract of a paper.)

Two-Dimensional Wing Theory in the Supersonic Range. H. Hönl. (*Kaiser Wilhelm-Institut für Strömungsforschung, ZWB/FB/Re/1903*, January 6, 1944.) *U.S., Army Air Forces, Translation No. F-TS-916-RE*, January, 1947. 25 pp., figs.

The plane problem of the vibrating wing in supersonic flow is discussed and solved by the acceleration potential method, on the basis of a linearized theory.

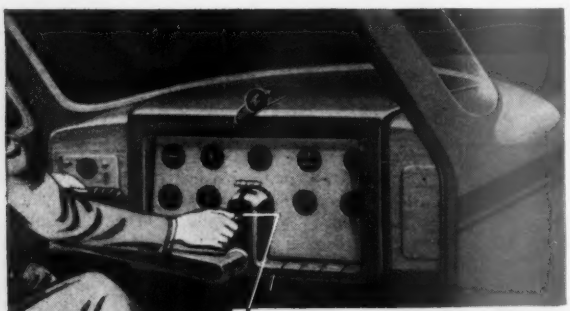
Method of Characteristics for Three-Dimensional Axially Symmetrical Supersonic Flows. R. Sauer. (*ZWB/FB/1269*, August 14, 1940.) *U.S., N.A.C.A., Technical Memorandum No. 1133*, January, 1947. 35 pp., figs.

The potential equation was transformed into a system of coordinates adjusted to Mach's net of curves and variable from point to point; there resulted a partly graphical, partly analytic method of iteration for determining three-dimensional axially symmetric supersonic flows. This method was applied to the examination of the flow in a conical nozzle and to the correction of a conical nozzle for a parallel outflow. The accuracy of the approximation method was tested by comparing the results with the exact theoretic calculations, and nearly complete agreement was obtained within the limits of construction accuracy.

The Air Forces of the Harmonically Vibrating Wing in Compressible Medium at Subsonic Velocity (Plane Problem). Dietze. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/1733*, January 20, 1943.) *U.S., Army Air Forces, Translation No. F-TS-506-RE*, November, 1946. 49 pp., figs. 7 references.

Method of the solution of a linear integral equation (first kind) for the lift distribution and a solution of an integral equation of the incompressibility problem. The lift distribution is composed of the lift distribution for incompressibility and an additional distribution correcting for compressibility with examples. The integral equation was introduced by Possio and developed by Kussner.

Plans and Three-Dimensional Flow at High Subsonic Speeds. B. Göthert. (*Lilienthal-Gesellschaft für Luftfahrtforschung,*



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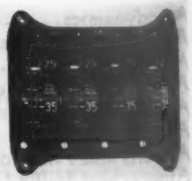

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Bericht 127.) *U.S., N.A.C.A., Technical Memorandum No. 1105,* October, 1946. 17 pp., figs.

For two- and three-dimensional flow in a compressible medium, a simple relation is given by which the quantitative influence of compressibility upon the velocities and pressures can be made clear, to a first approximation. In the application of this relation the distinct behaviors of two-dimensional and axially symmetric three-dimensional flow with increasing Mach Number are brought out. For slender elliptic cylinders and ellipsoids of revolution, calculations are made of the Mach Number at which local sonic velocity is achieved on the body. It is shown that the increase in the lift of a wing of finite span with Mach Number at a given angle of attack is greatly dependent upon the aspect ratio.

The Effect of Geometric Dihedral on the Aerodynamic Characteristics of a 40° Swept-Back Wing of Aspect Ratio 3. Bernard Maggin and Robert E. Shanks. *U.S., N.A.C.A., Technical Note No. 1169,* December, 1946. 25 pp., figs. 3 references.

Results indicated that, for low and moderate lift coefficients, changes in geometric dihedral from −10° to 10° resulted in a change in the effective dihedral that was about 75 per cent as great as that obtained for an unswept wing of aspect ratio 6. For dihedral angles outside the range of −10° to 10°, changes in geometric dihedral produced about half as much change in effective dihedral as for dihedral angles between −10° and 10°. At a lift coefficient above a value of 0.8, the maximum values of effective dihedral obtained with large negative geometric dihedral angles were greater than those obtained with 0° geometric dihedral. Over the linear range of the lift curve, the directional-stability parameter generally increased with increasing negative dihedral and increasing lift coefficient, but did not change appreciably with increasing positive dihedral. Increasing positive dihedral resulted in an increase in the nosing-up pitching moments (destabilizing) at the stall, and increasing negative dihedral resulted in an increase in nosing-down moments (stabilizing) at the stall. Increasing positive or negative dihedral caused a decrease in the lift-curve slope and an increase in the variation of lateral force with sideslip.

Contributions to Sweep-Back Research. H. Luetgebrune. *U.S., Army Air Forces, Translation No. F-TS-684-RE,* December, 1946. 75 pp., figs.

A comprehensive program of measurement on wings of different sweepback, taper ratio, and aspect ratio shows that the slope of the lift curve is not influenced by sweepback. The maximum lift coefficient increases with increasing positive sweepback. The pitching moment of the swept-back wing is determined from the customary lift distribution calculation of unswept wings. For strongly swept-back wings, the pitching moments calculated in this manner show considerable discrepancy with the measurements. The calculation of rolling moments due to yaw for unswept-back wings is in good agreement with the measurements. An investigation of landing aids for increasing the maximum lift was made with the following results: Leading-edge slots are favorable at all sweep angles. The rotatable nose is inferior to the leading-edge slots. For wings with strong positive sweepback, end plates and fences are not found to be usable. The split flap and the camber flap are more suitable than the slotted flap. The effect of the split flap in increasing the lift decreases markedly for strongly swept wings. A method is indicated, using special flaps, of obtaining a superior increase of lift. The maximum lift coefficient and the moment of a wing with any sweepback and with flaps may be calculated.

Pressure-Distribution Measurements on a Straight and on a 35° Swept-Back Tapered Wing. A. Thiel and J. Weissinger. (*Deutsche Versuchsanstalt für Luftfahrt, Untersuchungen und Mitteilungen No. 1293,* September 29, 1944.) *U.S., N.A.C.A., Technical Memorandum No. 1126,* January, 1947. 9 pp., figs. 6 references.

Spanwise lift-distribution measurements in straight airflow on a straight wing and a 35° swept-back tapered wing of given aspect and taper ratio (both of N.A.C.A. section 0012 and with semicircular tips), are compared with theory for two angles of attack each (6° and 12°) in the unstalled range of flow. A conspicuous feature of the chordwise distribution for the 12° angle for each wing is the marked reduction of the suction peaks in the center of the swept-back wing, the center-of-pressure point of these profile sections being shifted backward by the sweepback. The spanwise lift distributions of both wings for 6° and 12° angles show that the sweepback lowers the total lift and shifts the center of pressure of the load toward the tip, although not as much at the 12° angle as at the 6° angle.

One-Dimensional Flows of a Gas Characterized by van der Waal's Equation of State. Hsue-Shen Tsien. *Journal of Mathematics and Physics,* Vol. 25, No. 4, January, 1947, pp. 301–324, tables. 5 references.

The specific heat of the gas at constant volume is assumed to vary only with the temperature according to a quadratic law. Since for most applications envisaged the deviation of the results from the conventional ones for a perfect gas of constant specific heats is expected to be not more than 10 per cent, the method of small perturbation is used so that terms of second order in the deviations from the perfect gas can be neglected. The particular problems solved are the isentropic expansion in a nozzle and the normal shock in supersonic flows. The calculation was prompted by the recent interest in hypersonic wind tunnels, where extremely large expansion ratios are involved and the deviations from the perfect gas are not negligible.

Comparison of High-Speed Tests on Several Airplane Models. Lienarz. (*Oberammergau, Oberbayerische Forschungsanstalt, ZWB/UM/7823,* June, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1042-RE,* February, 1947. 50 pp., figs. 9 references.

For the types Me 163B, Me 262, Me 328, He 177, He 219, Ar 234, and Ju 287 the effect of the Mach Number is investigated for the total drag of parts and groups of parts, for center of pressure, moments in diving, and downwash angle.

Flight Investigation of Boundary-Layer Control by Suction Slots on an NACA 35-215 Low-Drag Airfoil at High Reynolds Numbers. John A. Zalovcik, J. W. Wetmore, and Albert E. von Doenhoff. *U.S., N.A.C.A., Advance Confidential Report No. 4B29* (*Wartime Report No. L-521*), February, 1944. 33 pp., illus. 2 references.

On the Plane Potential Flow Past a Lattice of Arbitrary Airfoils. I. E. Garrick. *U.S., N.A.C.A., Advance Restricted Report No. 4A07* (*Wartime Report No. L-313*), January, 1944. 49 pp., figs. 4 references.

Wind-Tunnel Tests of Two Tapered Wings with Straight Trailing Edges and with Constant-Chord Center Sections of Different Spans. Robert H. Neely. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-332*), March, 1943. 19 pp., figs. 2 references.

Additional Design Charts Relating to the Stalling of Tapered Wings. Sidney M. Harmon. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-271*), January, 1943. 16 pp., figs. 4 references.

A Method for Calculating Heat Transfer in the Laminar Flow Region of Bodies. H. Julian Allen and Bonne C. Look. *U.S.,*

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

N.A.C.A., Restricted Bulletin (Wartime Report No. W-7), December, 1942. 16 pp., figs. 12 references.

Formulas for Use in Boundary-Layer Calculations on Low-Drag Wings. E. N. Jacobs and A. E. von Doenhoff. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-319)*, August, 1941. 8 pp., fig. 3 references.

Effects of Heat-Capacity Lag in Gas Dynamics. Arthur Kantrowitz. *U.S., N.A.C.A., Advance Restricted Report No. 4A22 (Wartime Report No. L-457)*, January, 1944. 45 pp., figs. 18 references.

On Projectiles of Minimum Wave Drag. William R. Sears. *Quarterly of Applied Mathematics*, Vol. 4, No. 4, January, 1947, pp. 361–366.

An analogy between the wave resistance of a slender projectile and the induced drag of a wing already mentioned by von Kármán is amplified. This analogy suggests a useful form for the calculation of the wave drag. The properties of projectiles of minimum wave drag for given length and volume, and for given length and caliber, are then investigated. A somewhat similar analysis of projectile shapes for minimum wave resistance was made by Haack, who considered only symmetric projectiles. The results obtained in the present analysis are in agreement with Haack's for such projectiles, except for the value of the drag of the minimum-wave-drag body for given length and volume, which seems to have been tabulated erroneously in the earlier paper.

Investigation of Pressure Distribution on Fast Flying Bodies. G. Stamm. (*Germany, Zentrale für Wissenschaftliches Berichtswesen der Luftfahrtforschung, Untersuchungen und Mitteilungen Nr. 8103.*) *U.S., N.A.C.A., Technical Memorandum No. 1101*, September, 1946. 8 pp., figs.

A projectile with the speed of 1,550 m. per sec. was expended in order to test how far reaching the destructive effects caused by the bow wave of an especially fast-flying body will be. The pressure distribution around the projectile was measured by means of an interference method. The result was that the pressure increases with about the square of the speed and that the destructive effects caused by the bow wave can be attained, even at a caliber of 1.8 m., by a quantity of explosive matter no larger than about 20 Gm.

The Boundary Layer in a Corner. G. F. Carrier. *Quarterly of Applied Mathematics*, Vol. 4, No. 4, January, 1947, pp. 367–370, table. 3 references.

The laminar flow of a relatively nonviscous fluid through a channel is characterized by the presence of a thin boundary layer along the walls. In straight channels, such boundary layers are usually assumed to have the velocity distribution determined by Blasius for the flow past a flat plate, and the flow pattern in the neighborhood of any corner is not mentioned. Equations are developed for determining the change in the Blasius flow implied by such a corner.

Compressible Flow in a Convergent-Divergent Nozzle. G. Temple and Jennifer Yarwood. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2077*, September, 1942. 16 pp., figs. 4 references. British Information Services, New York. $0.90.

The report gives a representation of a paper by F. von Ringleb titled "Exact Solutions of the Differential Equations of an Adiabatic Gas Flow." That paper (1) provides the first example of an exact solution of the equations of compressible flow in which the fluid velocity rises from subsonic to supersonic values and returns without passage through a shock wave; and (2) suggests a new criterion for the breakdown of steady irrotational flow under supersonic conditions, according to which the local Mach Number at which breakdown occurs is definitely greater than unity. It is based on the hodograph equations in which the independent variables are the magnitude and the direction of the fluid velocity, while the dependent variables are the velocity potential and the stream function. The calculations show that local Mach Numbers considerably greater than unity can be attained without the subsequent development of shock waves, and that the maximum local Mach Number attainable varies with the field of flow considered.

Measurements of Friction Coefficients in a Pipe for Subsonic and Supersonic Flow of Air. Joseph H. Keenan and Ernest P. Neumann. *U.S., N.A.C.A., Advance Restricted Report No. 3G15 (Wartime Report No. W-44)*, July, 1943. 34 pp., figs. 6 references.

Investigation of Flow Through an Intercooler Set at Various Angles to the Supply Duct. Mark R. Nichols. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-408)*, April, 1942. 19 pp., figs.

The Effect of Mean Incidence, Amplitude of Oscillation, Profile and Aspect Ratio on Pitching Moment Derivatives. J. B. Bratt and K. C. Wight. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2064*, June 4, 1945. 50 pp., figs. 6 references. British Information Services, New York. $2.70.

The wattmeter harmonic analyzer used in conjunction with the magnetostriction stress indicator has been extended to give both the in-phase and the out-of-phase components of the fundamental in the aerodynamic pitching moment on an airfoil oscillating about a spanwise axis. Principal results show that the damping becomes negative for small values of the frequency parameter as the stalling angle is approached, but at larger values it remains positive. Both components vary with amplitude, the rate of change depending on the values of amplitude and frequency parameter. The most marked effect occurs in case of an elliptic profile for which the damping at 0° mean incidence becomes extremely small at the high values of frequency parameter. Both in-phase and out-of-phase components increase numerically with aspect ratio at 0° mean incidence; negative damping may be made positive by a reduction in aspect ratio.

Lifting-Surface-Theory Aspect-Ratio Corrections to the Lift and Hinge-Moment Parameters for Full-Span Elevators on Horizontal Tail Surfaces. Robert S. Swanson and Stewart M. Crandall. *U.S., N.A.C.A., Technical Note No. 1175*, February, 1947. 59 pp., figs. 17 references.

A limited number of lifting-surface-theory solutions for wings with chordwise loadings resulting from angle of attack, parabolic-arc camber, and flap deflection are now available. These solutions were studied to see how they could be used to determine lifting-surface-theory values of the aspect-ratio corrections to the lift and hinge-moment parameters for both angle-of-attack and flap-deflection-type loading. Those values could be used to predict the characteristics of horizontal tail surfaces from section data with sufficient accuracy for engineering purposes. Such a method was devised for horizontal tail surfaces with full-span elevators. In spite of the complex theory, the method may be simply applied without any knowledge of lifting-surface theory. A comparison of experimental finite-span and section values and of the estimated values of the lift and hinge-moment parameters for three horizontal tail surfaces was made to provide an experimental verification of the method.

Pressure Distributions and Force Tests of an NACA 65-210 Airfoil Section with a 50-Percent-Chord Flap. Milton M. Klein. *U.S., N.A.C.A., Technical Note No. 1167*, January, 1947. 68 pp., figs. 2 references.

The tests were carried out for flap deflections of 0°, 4°, 7°, and 10°. The data showed that these flap deflections provided considerably reduced drag coefficients at lift coefficients above the design range of the plain airfoil. The variation of maximum lift, minimum drag, and pitching moment at minimum drag with flap deflection were nearly linear, within the range of flap deflections tested. The measured increments of the pitching moment and of the angle of zero lift resulting from flap deflection compared satisfactorily with those calculated from thin-airfoil theory.

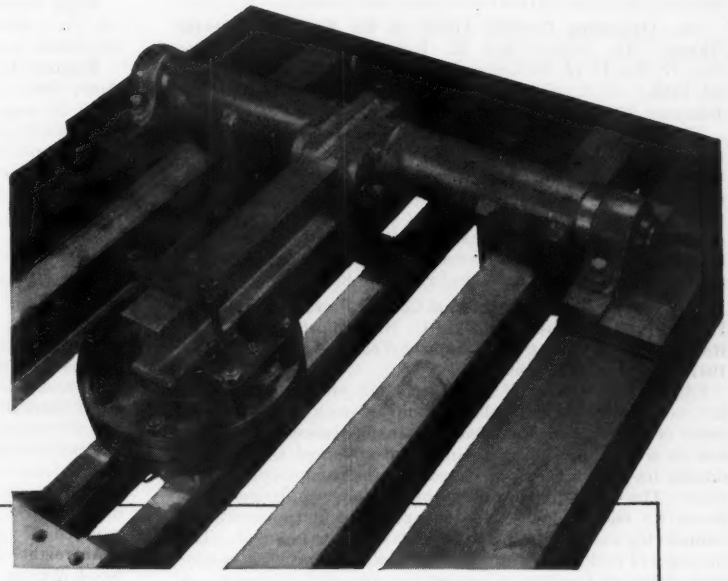
Wind-Tunnel Investigation of 20-Percent-Chord Plain and Frise Ailerons on an NACA 23012 Airfoil. F. M. Rogallo and Paul E. Purser. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-374)*, December, 1941. 32 pp., figs. 16 references.

Characteristics of NACA 4400R Series Rectangular and Tapered Airfoils, Including the Effect of Split Flaps. Harry Greenberg. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-493)*, January, 1941. 15 pp., figs. 7 references.

Wind-Tunnel Investigation of an NACA 23012 Airfoil with Two Sizes of Balanced Split Flap. Thomas A. Harris and Paul E. Purser. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-441)*, November, 1940. 32 pp., figs. 14 references.

The Monoplane as a Lifting Vortex Surface. Hermann Blenk. (*Zeitschrift für Angewandte Mathematik und Mechanik*, Vol. 5,

MEASURING THRUST OF JET ENGINES *and* ROCKETS *with* HAGAN THRUSTORQ



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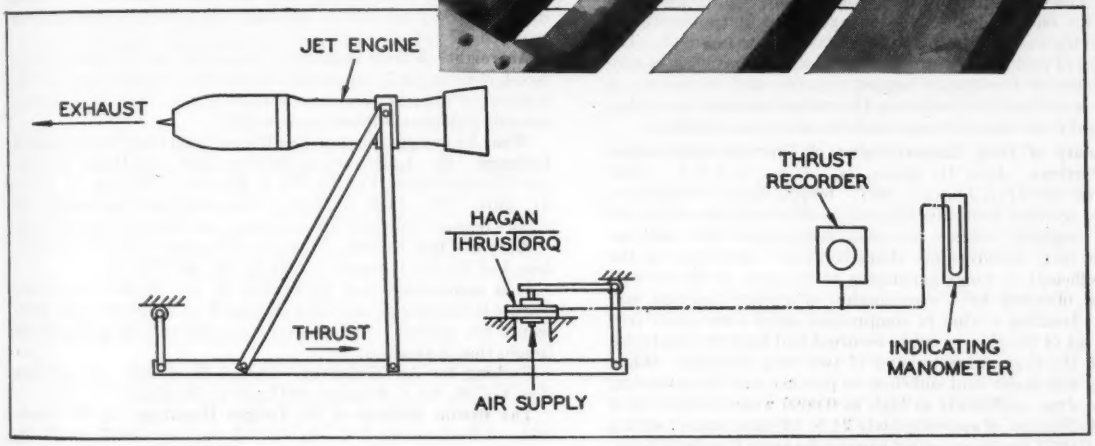

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No. 1, February, 1925.) *U.S., N.A.C.A , Technical Memorandum No. 1111*, February, 1947. 31 pp., figs. 5 references.

In Prandtl's airfoil theory the monoplane was replaced by a single lifting vortex line and yielded fairly practical results. Yawed wings and those curved in the direction of flight could not be computed by the use of Prandtl's theory as a first approximation, because for these the chordwise lift distribution must be taken into consideration. The transition from the lifting line to the lifting surface for the two-dimensional problem has been explained by Walter Birnbaum, and the present report undertakes the transition to the three-dimensional problem.

The Oscillating Circular Airfoil on the Basis of Potential Theory. Th. Schade and K. Krienes. (*Luftfahrtforschung*, Vol. 17, No. 11-12, December 10, 1940; Vol. 19, No. 8, August 20, 1942.) *U.S., N.A.C.A., Technical Memorandum No. 1098*, February, 1947. 38 pp., figs. 6 references.

The report treats the problem of the circular airfoil in uniform airflow executing small oscillations, the amplitudes of which correspond to whole functions of the second degree. The pressure distribution is secured by means of Prandtl's acceleration potential. It results in a system of linear equations, the coefficients of which can be calculated exactly with the aid of exponential functions and Hankel's functions. The equations necessary are derived in part I; the numerical calculation follows in part II.

Flight Measurements of Internal Cockpit Pressures in Several Fighter-Type Airplanes. Edward C. B. Danforth and John P. Reeder. *U. S., N.A.C.A., Technical Note No. 1173*, February, 1947. 29 pp., illus. 1 reference.

Flight measurements of internal cockpit pressure were made in several fighter-type airplanes equipped with either conventional or bubble canopies. Data are presented showing the variation in cockpit pressure with indicated air speed and angle of sideslip for both the canopy-closed and the canopy-open conditions. The effect of admitting the cockpit ventilating air is shown for one airplane. The change in cockpit pressure accompanying a change in engine power is shown to be small. The variation of cockpit pressure with normal acceleration at a constant value of free-stream impact pressure also is shown. A method is outlined for predicting the cockpit pressure in accelerated flight from measurements made in unaccelerated flight.

Summary of Drag Characteristics of Practical-Construction Wing Sections. John H. Quinn, Jr. *U.S., N.A.C.A., Technical Note No. 1151*, January, 1947. 69 pp., illus. 5 references.

Airfoil sections were investigated to determine the effects of surface roughness, surface waviness, compressive load, and deicers on their aerodynamic characteristics. Decreases in the drag coefficient of wings amounting to as much as 50 per cent could be obtained by a combination of surface finishing and fairing. Loading a wing in compression until some slight permanent set of the skin or rivets occurred had little or no adverse effect on the drag characteristics of two wing sections. While the wing was under load sufficient to produce such deformation, however, drag coefficients as high as 0.0060 were obtained at a Reynolds Number of approximately 24×10^6 as compared with a value of 0.0045 for the unloaded wing at the same Reynolds Number. Airfoil sections having thickness ratios of approximately 15 per cent and equipped with leading-edge deicer boots were found to have section drag coefficients of approximately 0.0070 at Reynolds Numbers between 10×10^6 and 32×10^6. This value of the section drag coefficient appeared to be independent of the airfoil section upon which the deicer was mounted.

Aerodynamically Favorable Fixed Antennas. Harmeming and Sudeck. (*Deutsche Versuchsanstalt für Luftfahrt, Forschungsbericht 414*, October 7, 1935.) *U.S., Army Air Forces, Translation No. F-TS-917-RE*, November, 1946. 15 pp., figs.

Experiments prove that the only practical way to reduce the air resistance of a fixed antenna is to reduce the diameter of the antenna and to use silvered steel wire.

Wind Tunnel Tests of a Submerged-Engine Fuselage Design. John V. Becker and Donald D. Baals. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-485)*, October, 1940. 27 pp., illus. 8 references.

Tests of a Large Spherical Turret and a Modified Turret on a Typical Bomber Fuselage. Axel T. Mattson. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-463)*, October, 1942. 14 pp., illus. 1 reference.

Wind-Tunnel Tests of Several Arrangements of External Auxiliary Fuel Tanks on a Fighter-Type Airplane. Edward Pepper. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-871)*, August, 1942. 23 pp., illus.

A Comparative Study of the Effect of Wing Flutter Shape on the Critical Flutter Speed. I. Irving Pinkel. *U.S., N.A.C.A., Advance Restricted Report No. 3K15 (Wartime Report No. L-413)*, November, 1943. 15 pp., fig. 3 references.

Air Transport—General

Ships Versus Aeroplanes. J. McWhirter. *Aeronautics*, Vol. 16, No. 1, February, 1947, pp. 54, 57. Some conclusions regarding future prospects are based on a study of competitive rates.

Regional Air Navigation Meetings in Dublin and Paris, March-April, 1946. *PICAO Journal*, Vol. 1, No. 4, March-April, 1946, pp. 3–52, maps.

Detailed reports are made of the work accomplished, dealing with airport facilities, traffic control, communications, meteorology, and search and rescue.

Air Transport, Cargo

An Area Basis for Air Cargo. John H. Frederick. *Distribution Age*, Vol. 46, No. 2, February, 1947, pp. 36, 46, 69.

Direct long-haul service saves the expense and delay of transshipment, enables the air line to "follow the crops," offers shippers alternative markets, and stimulates production of both agricultural and manufactured products by opening new markets.

Air Short Hauls Can Compete with Surface. Richard H. Rush. *Air Transport*, Vol. 5, No. 2, February, 1947, pp. 45–49, illus.

Consideration is given to short-haul economies that can be gained from air transport because of quick delivery of urgently needed goods, less spoilage and less time deterioration, more direct route by air, lighter packing, and less ice or refrigeration required.

Airfreight—A New Industry. *Tennessee Air Progress*, Vol. 1, No. 4, Winter, 1947, pp. 10–13, 23–25, illus. A historical sketch, a survey of current services and rates, and a discussion of seven recently published studies on air freight.

What Air Freight Carriers Can Expect from New York's Glamor Industry. II. L. H. Brittin, Bertram Ault, and Roger Mayhill. *Air Transportation*, Vol. 10, No. 1, January, 1947, pp. 16, 18–21, 41, illus. (Cf. AER 3/47:44.) Shipping and packaging, the export market, furs and fur garments, and dresses are discussed.

Keep the Ball Rolling. Thomas J. Eppley. *Air Transportation*, Vol. 10, No. 1, January, 1947, pp. 24, 38, illus.

It is emphasized that recognition of the foreign freight forwarder is not enough and that standardized procedure and documents are needed to release the vast amount of potential air freight that is available.

Packing for Air Shipment. Daniel H. Ecker. *Distribution Age*, Vol. 46, No. 1, January, 1947, pp. 41, 50, illus.

The Bristol Method of Air Freight Handling. J. H. Davis. *Aircraft Engineering*, Vol. 19, No. 215, January, 1947, pp. 27, 28, figs.

To complement the specialized design of the Bristol Type 170 Freighter for freight service, a system of cargo handling was developed which utilizes a series of standard containers to simplify allocation of floor area and economize space.

Air Transport, Scheduled

Airline Business Organization. Dick James Scott. *Western Flying*, Vol. 27, No. 2, February, 1947, pp. 18, 19, 38, 40, illus. The application of basic rules of good management is discussed.

What's Right with the Airlines? I. Herb Powell. *Air Transport*, Vol. 5, No. 2, February, 1947, pp. 21–25, illus.

A compilation of the replies received from air-line public relations' offices in response to inquiries sent by *Air Transport* requesting information about what had been done to remedy the faults which formed the subject of an article in *Fortune*, August, 1946.

Three Points of View. *The Aeroplane*, Vol. 72, No. 1862, January 31, 1947, pp. 125, 126. (Abstracts of three papers: Long-Distance Overseas Transport, Sir Frederick Handley Page. European Air Line Operations, N. E. Rowe. Airworthiness, W. Tye.)

Airplane Descriptions

Home-Made Roadable Readied by L. A. Inventors. *Aviation*, Vol. 46, No. 2, February, 1947, pp. 64, 65, illus.

S. D. Whitaker and D. D. Zuck are developing the prototype of a personal roadable airplane that has variable-incidence folding wings, retractable tail flaps, and a two-control system. An independently sprung three-wheel landing gear has been devised, with the front wheels steerable and cable-linked to the control wheel, and the rear wheel taking the transmission for driving on the ground.

New Shapes in the Air. III—The Auster A.O.P. Mk. VI Liaison and Reconnaissance; The Convair XL-13, Liaison and Ambulance. *The Aeroplane Spotter*, Vol. 8, No. 181, February 8, 1947, p. 29, illus.

The Wren "Goldcrest." *Flight*, Vol. 51, No. 1987, January 23, 1947, pp. 93, 94, illus.

The Wren Aircraft Co., Ltd., Carlisle (England), has built an ultra-light, single-seater airplane with a wing span of about 23 ft. It will be powered by a 30-hp. four-cylinder, two-stroke Wren engine.

Belfair in the Air. Maurice A. Smith. *Flight*, Vol. 51, No. 1988, January 30, 1947, p. 121; illus., 116b.

A brief description is given of the design and flight characteristics of the Belgian Fairey Belfair two-seater light airplane, an improved version of the prewar Tipsy B. Its cruising speed is 100 m.p.h. The wing span is 31 ft. 2 in.

Fiat Transport Marks Italian Comeback. *Aviation*, Vol. 46, No. 2, February, 1947, p. 66, figs.

The Fiat G-212, a large all-metal, three-engined Italian transport plane built with Allied sanction, is a medium-range, high-performance aircraft utilizing American or Italian power plants. Seating arrangements for from 20 to 40 passengers have been conceived for this low-wing monoplane. The fuselage, of duralumin monocoque fabrication, has flat bottom and sides and oval-shaped roof.

Pellarini Pusher. *Aeronautics*, Vol. 16, No. 1, February, 1947, p. 37, figs.

Some details about an Italian personal airplane that can be used for road travel and is provided with a nose-wheel type landing gear in which the position of the two rear wheels can be changed fore and aft in relation to the c.g. of the aircraft.

Food for Thought. *The Aeroplane*, Vol. 72, No. 1862, January 31, 1947, pp. 129, 130, figs.

In the Planet Satellite, a pusher-type low-wing cantilever monoplane powered by a 250 b.hp. Gypsy Queen engine, a new, purer-base magnesium alloy has been chosen as the constructional medium. An argon electric arc-welding process is to be employed throughout, in order to minimize further the likelihood of corrosion at the welds. It is claimed that simplicity and remarkable weight reduction have been achieved by these methods.

Structural Description: Junkers All-Metal Airplane Ju 290 A-3. (*Ju/290/Pa/3*, October, 1943.) *U.S., Army Air Forces, Translation No. F-TS-766-RE*, November, 1946. 39 pp., illus.

German Aircraft in Detail. VIII—The Junkers Ju 287. *The Aeroplane Spotter*, Vol. 8, No. 180, January 25, 1947, p. 16, illus. The design and development of a high-speed jet-propelled heavy bomber.

German Aircraft in Detail. IX—The Lippisch LP 13a. *The Aeroplane Spotter*, Vol. 8, No. 181, February 8, 1947, p. 32, illus. The characteristics of a ram-jet tailless supersonic research aircraft and of a glider version designated as DM 1.

T-2 Report on Frank-1 (KI-84), T-2 Serial No. 302, Interim Report No. 3, (Project No. NAD 25). R. J. Groseclose. *U.S., Army Air Forces, Interim Report No. F-IM-1119C-ND*, November, 1946. 12 pp. Description and performance characteristics of a Japanese Nakajima fighter.

Frank-1 (KI-84) Pilot's Handbook, Interim Report No. 2 (Project No. NAD-25). R. J. Groseclose. *U.S., Army Air Forces, Interim Report No. F-IM-1119B-ND*, January, 1947. 27 pp., illus. A single-seat, low-wing monoplane powered by an 18-cylinder, HA-45, Model 21 radial engine.

Nick-II (KI-45) Japanese Night Fighter (Project No. NTE-23). R. J. Groseclose. *U.S., Army Air Forces, Technical Report No. F-TR-1143-ND*, January, 1947. 8 pp.

U.S. Service Aircraft. *Flying*, Vol. 40, No. 3, March, 1947, pp. 52, 53. A table of specifications of 112 current military and naval aircraft.

The Seventeenth Salon. *Aircraft Engineering*, Vol. 19, No. 215, January, 1947, pp. 2–17, 26, illus. (Cf. AER 3/47:47.) An extensive review of the aircraft, engines, and accessories exhibited at the Paris Aero Show.

Soviet Sidelights. *The Aeroplane Spotter*, Vol. 8, No. 180, January 25, 1947, p. 20, illus.

Some Soviet aircraft seen at the Prague Air Display and Soviet Aviation Day celebrations in 1946 are described and illustrated.

Soviet Spotlight. *The Aeroplane Spotter*, Vol. 8, No. 181, February 8, 1947, p. 28, illus.

Brief data on the YaK-14 liaison and light transport, YaK-8 feeder-line transport, the TU-2 attack bomber, the YaK-3 fighter, the A.N.T. 44 flying boat, and other types.

Flygvapnet—Royal Swedish Air Force. John Stroud. *The Aeroplane Spotter*, Vol. 8, No. 181, February 8, 1947, pp. 30, 31, illus. Descriptions of current aircraft.

Airplane Design

Instability Analysis and Design of an Efficiently Tapered Plate under Compressive Loading. Samuel Pines and George Gerard. *Republic Aviation Corp.* (For abstract see "I.A.S. Briefs" on page 31 of this issue, April, 1947.)

Psychology and Aircraft Design. Paul M. Fitts. *Mechanical Engineering*, Vol. 69, No. 2, February, 1947, pp. 135–141, 163, illus.

A report on the work of the Psychology Branch of the Aero Medical Division at Wright Field and related groups in the Army Air Forces gives some results of research that has brought together the sciences of engineering and psychology. Preliminary information is given about a study to obtain from pilots themselves accounts of accidents, near-accidents, and other experiences in which difficulties were encountered in the use of equipment. A selected group of experiments in the field of psychological engineering was conducted on sizable groups of A.A.F. pilots. It is believed that the incidence of such experiences can be reduced by designing new equipment in relation to the psychologic capacities and human limitations of the user. Experimental designs were used that controlled in so far as possible such factors as learning and previous experience with existing equipment. The findings are based on statistical analysis of experimental data.

Weighing the Converted C-46. J. Robert Duppstadt. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 48, 133, illus.

Mechanical and electrical methods of determining the weight and c.g. of the plane for commercial use after installing various modifications.

Expensive Weight Saving. B. J. Vierling and Lan H. Caldwell. *SAE Journal*, Vol. 55, No. 2, February, 1947, p. 71. (Abstract of a paper: Weight Saving Can Be Expensive.)

Examples of how improper methods of weight-saving in transport-plane design can reduce passenger appeal, increase maintenance costs, and decrease operational efficiency.

High Speed Flight: The First Forty Years, The Advent of the Gas Turbine, Flight in the Future. S. G. Hooker. *Royal Society of Arts, Journal*, Vol. 94, No. 4714, March 29, 1946, pp. 265–296, figs.

Future flight will involve high-altitude civil and military machines, combinations of turbine and piston engines, improved fuels, pressure cabins, supersonic speeds, rockets, and atomic energy for aircraft.

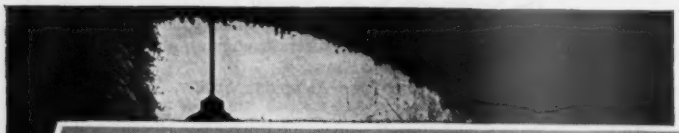
New Approach to Flight. W. B. Stout. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 50–52, illus. (Extended abstract of a paper: A New Approach to the Flight Problem.)

Aerodynamic advantages possessed by the flapping wing are described, and also experiments with mechanical devices for producing a flapping motion.

This Is Your Program. A. L. Morse. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 45–47. (Extended abstract of a paper.) An outline of the active and uncompleted projects of the C.A.A. Technical Development Service program.

Flight: Airborne, Thrustborne, Momentumborne. Chet Miller. *Douglas Airview*, Vol. 13, No. 9, November, 1946, pp. 3–5, 23, illus.

Developments and possibilities in the design and propulsion of various types of aircraft, rockets, and missiles, classified into three groups according to their mode of flight and the means by which lift (or thrust) is obtained.



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Speed's Up—and So's Fighter Design Cost. Winthrop Brubaker. *The Bee-Hive*, Vol. 22, No. 1, January, 1947, pp. 18–22, illus.

Problems of external finish, fairing, relocation of equipment, structural layout, Army and Navy specifications, and other questions have added greatly to the difficulty of economically designing high-speed fighter aircraft.

Delta Design. William S. Friedman. *Air Force*, Vol. 30, No. 2, February, 1947, pp. 51–53, illus.

The three functions of swept-back wings are explained. Problems peculiar to sweepback design are described in nontechnical language.

Round and Square. Boffin. *Air Reserve Gazette*, Vol. 9, No. 9, February, 1947, pp. 53, 54, figs.

Recent research results have focused attention on the ultra-low-aspect-ratio airplane, and there are indications that designs with an aspect ratio of 1 : 1 or 1 : 2 may be a solution to immediate sonic and transonic drag and stability problems. Investigations of "square" and "circular" tailless airplanes carried out by three American engineers during the early 1930's in an effort to solve stability problems are discussed.

Airports and Airfields

Airport Planning. David Brise. *Flight*, Vol. 51, No. 1990, February 13, 1947, pp. 168–170, illus. Problems and difficulties encountered in laying out airports to meet present-day requirements are discussed.

The Cargo Airport. *Airports & Air Transportation* (London), Vol. 1(N.S.), No. 44, January, 1947, pp. 359, 360, diagr. Some principles for designing an airport for cargo traffic only.

Airports—A New National Investment. *Engineering News-Record*, Vol. 138, No. 8, February 20, 1947, pp. 131–133, tables.

Details about the projected civilian airport construction program, which involves expenditures of a billion dollars, half provided by the Government over a period of 7 years.

Airports 16 Miles Square? *Southern Flight*, Vol. 27, No. 2, February, 1947, pp. 32, 33, illus.

Some comments on court decisions regarding the altitude requirements for aircraft approaching airports and their effect on airport size.

Surplus Radios for Small Airport Use; Helpful Suggestions on Selecting Surplus Transmitters and Receivers for Conversion to Private Control Tower Work. Karl H. Stello. *Southern Flight*, Vol. 27, No. 2, February, 1947, pp. 35, 36.

Inexpensive Lighting System Tested. *Airports*, Vol. 11, No. 2, February, 1947, pp. 28, 29, illus.

Details of a low-cost, two-color, gaseous-tube boundary-lighting system which has been installed on a trial basis at Aretz Airport, Lafayette, Ind.

Low Cost Traffic Control. Robert C. Blatt. *Aviation Maintenance & Operations*, Vol. 7, No. 3, February, 1947, pp. 21–24, 88, 90, illus.

How to equip the small airport with wind and landing-direction indicators for insuring safe and efficient traffic control.

Airways and Traffic Control

Integrated Landing System. Charles S. Moffett. *Air-Sea Safety*, Vol. 2, No. 2, February, 1947, pp. 21–35, illus.

Results and recommendations of the Army, Navy, and C.A.A. investigations at the Navy's Landing Aids Experiment Station, Arcata, Calif. Through comparative analysis and correlated tests, it is found that the most reliable method for landing aircraft under conditions of low visibility must involve the use of three landing-aids systems: (1) G.C.A. (Ground Controlled Approach) or I.L.S. (Instrument Landing System); (2) a system of high-intensity approach and runway lights to aid in establishing visual contact; (3) high-pressure fog dispersal (FIDO) equipment to insure visual contact with the runway under conditions of greatly reduced visibility due to heavy fog. Estimates on the cost of construction and operation, as well as typical summaries of flight-test results for performance of the integrated system under low-visibility conditions are included.

Navigational Aids. I. P. J. Day. *Airports & Air Transportation* (London), Vol. 1(N.S.), No. 44, January, 1947, pp. 341–347, illus.

The design of the new miniaturized air-borne Gee radio navigation sets is well advanced and production prototypes are being developed. The miniature equipment is described and compared with the larger Mark II version.

Britain's Radar Traffic Control. M. G. Scroggie. *Western Flying*, Vol. 27, No. 2, February, 1947, pp. 32, 34, figs.

A discussion of traffic-control problems with particular attention to safety of operation. The features of the Gee system and the Decca Navigator are compared.

Air Traffic Control. Donald H. Ogilvy. *Air Facts*, Vol. 10, No. 2, February 1, 1947, pp. 46–56.

The duties of the airport traffic controller and the functions of the Airways Traffic Control Centers are described. Improvements in operational methods are suggested.

Operation Granite. D. West. *Aeronautics*, Vol. 16, No. 1, February, 1947, pp. 47–49, figs.

Measures taken by the Royal Air Force and Royal Observer Corps to prevent aircraft flying into high ground are described. They involved lighting places in the path of aircraft observed to be flying toward high ground. Diagrams show how accidents were reduced in different areas.

Idea for a Plotting Table. *The Aeroplane*, Vol. 72, No. 1862, January 31, 1947, p. 139, illus.

The lower shelf of the table carries a map of the flight region with the control zones marked in, and other shelves represent stated altitude levels. Small model airplanes enable the control officer to visualize the traffic situation aloft.

Business and Finance

Experiment at Republic. *Fortune*, Vol. 35, No. 2, February, 1947, pp. 123–125, 164, 167, 170, 172, illus.

After a review of the history of Republic Aviation Corporation and its contributions to the war effort and to advanced research in military aircraft, the company's reconversion problems are outlined.

Lightplane Bust or Boom? Scott Hershey. *Flying*, Vol. 40, No. 3, March, 1947, pp. 17, 18, 92, 94, charts. An examination of the current condition of the light-plane industry.

The Engineering Outlook. IV—The Aircraft Industry. *Engineering*, Vol. 163, No. 4228, January 24, 1947, pp. 77, 78, tables.

A review of the activities of the British aircraft industry, with comments on its future prospects. Tables give brief particulars about British civil aircraft, figures on United Kingdom imports and exports of aircraft, and figures on international aircraft exports.

Comfort in Aircraft

Airplane Quieting. I—Measurement of Sound Levels in Flight. II—Specification of Acceptable Noise Levels. L. L. Beranek and H. Wayne Rudmose. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 2, February, 1947; pp. 89–95, figs. 14 references; pp. 97–100, figs. 7 references. (Cf. AER 3/47 : 53.)

I. The types and use of equipment for the measurement of noise in aircraft are described and an outline is given of measurement procedures that will yield data of maximum value to the acoustical design engineer. The use of a standard sound-reference level, of root-mean-square indicating meters, and of "flat" response-measuring equipment is urged. Relative advantages of the three principal types of noise meters and specifications that the individual components of the noise-measuring equipment should meet are discussed. The averaging characteristics of 17 commercially available audio-frequency indicating instruments are shown. Suggested procedures for analyzing noise in aircraft during flight are presented.

II. For determining the effect of aircraft noise on the ability of passengers to converse during flight, account is taken of the distance between the talker and listener, the voice intensity, and the character of the noise in the cabin. Experimental data are given to confirm the validity of the method.

Air Conditioning Turbine-Propelled Aircraft. I. H. J. Wood. *Aviation*, Vol. 46, No. 2, February, 1947, pp. 49–52, figs.

Advent of aircraft capable of more than 500 m.p.h. has made provision for cabin cooling an absolute necessity. The air-cycle system, which may take many forms, appears to be the lightest and most practical refrigeration method for aircraft with gas-turbine power plants but the design of such systems must be closely integrated with airplane and power-plant design. Although the possible combinations are many, all air-cycle systems share the principle of using the expansion of air in a turbine to reduce its temperature substantially below ambient values. Other means of cooling airplane cabins might be used but weight and bulk considerations so far have strongly favored this plan. Cockpit cooling methods that differ from the air-cycle type are briefly discussed. Air-cycle systems that bleed their supply of compressed air from the compressor of the turbine are described.

Passenger Comfort in Commercial Aviation. A. D. Tuttle *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 584–589.

Survey carried on continuously since 1938 now covers over 4,000,000 passengers transported by United Air Lines from 1938–1945, inclusive.

Air Conditioning of Military Aircraft. H. J. Wood. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 58–62, figs. (Extended abstract of a paper: Air Conditioning of Turbine-Propelled Military Aircraft.)

Practical problems of air conditioning are discussed with particular reference to those aircraft in which a source of compressed air is available and used with an air-cycle system for cockpit cooling. Only air-cycle systems that bleed their supply of compressed air from the compressor of a gas turbine are discussed. Consideration is given to cooling problems, the capacity of air-cycle systems, criteria for the choice of systems, and practical installation problems.

Mock-Up Tests Prove Air Conditioning for Planes. W. W. Thayer. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 84, 85, illus. (Abstract of a paper: Proof Testing the DC-6 Air Conditioning System for Passenger Comfort.)

Rainbow Air Conditioning. P. E. R. Brice. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 66, 67, figs. (Abstract of a paper: Factors Affecting the Design of the Air Conditioning and Pressurizing System for the Republic Rainbow Airplane.)

Control Systems

Latest Developments in Aircraft Controls and Instrumentation. R. A. Brown. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 2, February, 1947, pp. 109–116, illus.

The provision of automatic controls has become a necessity to relieve the pilot and other operating personnel of the strain of continual manual control throughout flight periods. Electrical, pneumatic, and hydraulic devices have been developed to accomplish reduction in manual functions but these must be controlled automatically by sensing elements that react to conditions encountered. Details are given about a basic control system having varied applications.

An Instrument to Measure Servomechanism Performance. H. I. Tarpley. *The Review of Scientific Instruments*, Vol. 18, No. 1, January, 1947, pp. 39–43, figs. 5 references.

A recorder for measuring transients applied to positioning servomechanisms consists, essentially, of a bank of condensers on which the transient voltages are successively impressed, later read from a cathode-ray oscillograph screen and then plotted as a function of time to reveal the nature of the transient.

Description of Servomotor LRM 12 d. *U.S., Army Air Forces, Translation No. F-TS-489-RE*, January, 1947. 23 pp., illus.

The LRM 12 d servomotor is an electrohydraulic reinforcing device, in which the delivery pressure is produced by a gear pump coupled with a motor. The oil flow is controlled electrically and operates a working piston that transmits its motion to a secondary driving shaft. The electrical connection is made by means of a 14-pole plug. For the secondary drive, spur gearing is provided on the secondary drive shaft for the mounting of a coupling lever. A detailed description is given of the materials, construction, and operation of the device.

Instructions for Installing Servomotor LRM 12. (*Siemens, Erprobungsbericht 103.*) *U.S., Army Air Forces, Translation No. F-TS-488-RE*, November, 1946. 9 pp., figs.

Wind-Tunnel Investigation of Control-Surface Characteristics. *U.S., N.A.C.A.*

III—A Small Aerodynamic Balance of Various Nose Shapes Used with a 30-Percent-Chord Flap on an NACA 0009 Airfoil. Milton B. Ames, Jr. *Advance Restricted Report* (*Wartime Report No. L-301*), August, 1941. 40 pp., figs. 7 references.

VII—A Medium Aerodynamic Balance of Two Nose Shapes Used with a 30-Percent-Chord Flap on an NACA 0015 Airfoil. Richard I. Sears and H. Page Hoggard, Jr. *Advance Restricted Report* (*Wartime Report No. L-448*), July, 1942. 24 pp., figs. 8 references.

VIII—A Large Aerodynamic Balance of Two Nose Shapes Used with a 30-Percent-Chord Flap on an NACA 0015 Airfoil. Richard I. Sears and Clarence L. Gillis. *Advance Restricted Report* (*Wartime Report No. L-378*), July, 1942. 22 pp., figs. 9 references.

IX—Some Analytical Considerations and Experimental Test Results for an Internally Balanced Flap. Richard I. Sears. *Advance Restricted Report* (*Wartime Report No. L-339*), July, 1942. 27 pp., figs. 8 references.

XII—Various Cover-Plate Alinements on the NACA 0015 Airfoil with a 30-Percent-Chord Flap and Large Sealed Internal Balance. H. Page Hoggard, Jr. *Advance Restricted Report* (*Wartime Report No. L-511*), January, 1943. 26 pp., figs. 3 references.

Characteristics of Beveled-Trailing-Edge Elevators on a Typical Pursuit Fuselage at Attitudes Simulating Normal Flight and Spin Conditions. Clarence L. Gillis. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-391*), December, 1942. 31 pp., figs. 9 references.

The Development of Satisfactory Flying Qualities on the Douglas Dive Bomber, Model SBD-1 Through Flight Testing Successive Modifications in Control-Surface Area, Hinge-Line Location, and Aerodynamic-Balance Nose Shape. L. E. Root. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. W-81*), May, 1942. 62 pp., figs. 1 reference.

Theory and Preliminary Flight Tests of an All-Movable Vertical Tail Surface. Robert T. Jones and Harold F. Kleckner. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-496*), January, 1943. 29 pp., illus. 7 references.

Characteristics of Plain and Balanced Elevators on a Typical Pursuit Fuselage at Attitudes Simulating Normal-Flight and Spin Conditions. Richard I. Sears and H. Page Hoggard, Jr. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-379*), March, 1942. 46 pp., figs. 8 references.

Wind-Tunnel Tests of Hinge-Moment Characteristics of Spring-Tab Ailerons. Frederick H. Imlay and J. D. Bird. *U.S., N.A.C.A., Advance Restricted Report No. 4A26* (*Wartime Report No. L-318*), January, 1944. 29 pp., figs. 5 references.

Wind-Tunnel Investigation of Trimming Tabs on a Thickened and Beveled Aileron on a Tapered Low-Drag Wing. F. M. Rogallo and Stewart M. Crandall. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. L-435*), March, 1943. 32 pp., figs. 4 references.

Application of Balancing Tabs to Ailerons. Richard I. Sears. *U.S., N.A.C.A., Restricted Bulletin* (*Wartime Report No. L-346*), June, 1942. 16 pp., figs. 4 references.

Wind-Tunnel Investigation of a Spoiler-Slot Aileron on an NACA 23012 Airfoil with a Full-Span Fowler Flap. F. M. Rogallo and Bartholomew S. Spano. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-376*), December, 1941. 7 pp., figs. 7 references.

Wind-Tunnel Investigation of a Plain and a Slot-Lip Aileron on a Wing with a Full-Span Flap Consisting of an Inboard Fowler and an Outboard Slotted Flap. F. M. Rogallo and Marvin Schuldenfrei. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-421*), June, 1941. 18 pp., figs. 3 references.

Aerodynamic Characteristics of a Slot-Lip Aileron and Slotted Flap for Dive Brakes. F. M. Rogallo. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. L-337*), April, 1941. 9 pp., figs. 3 references.

Wind-Tunnel Investigation of a Plain and a Slot-Lip Aileron on a Wing with a Full-Span Slotted Flap. Francis M. Rogallo and Bartholomew S. Spano. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. L-375*), April, 1941. 33 pp., figs. 7 references.

A Study of the Application of Data on Various Types of Flap to the Design of Fighter Brakes. Paul E. Purser. *U.S., N.A.-*

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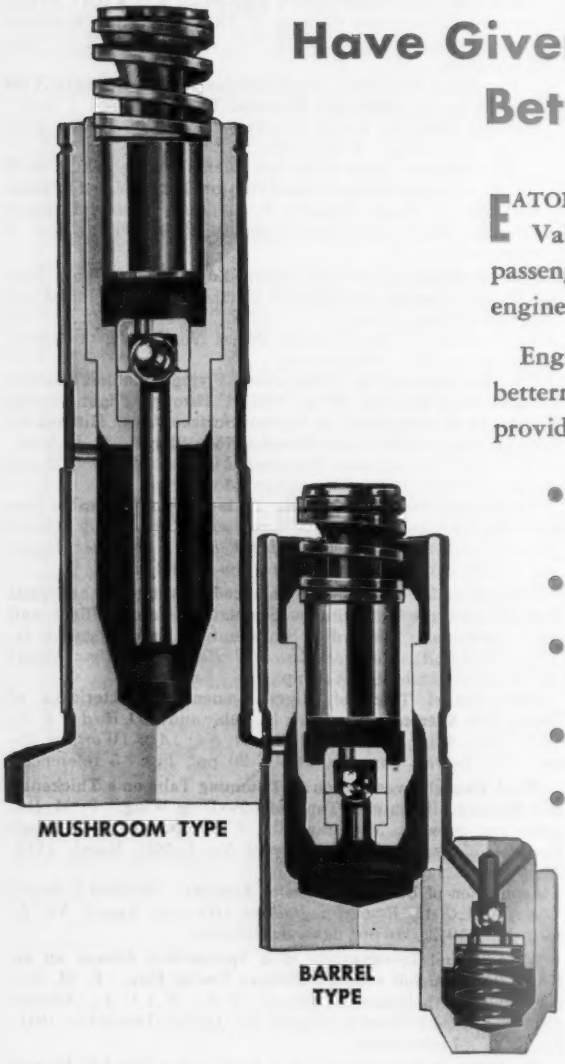

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C.A., Advance Confidential Report (Wartime Report No. L-414), June, 1942. 17 pp., figs. 4 references.

Wind-Tunnel Investigation of Plain Ailerons for a Wing with a Full-Span Flap Consisting of an Inboard Fowler and an Outboard Retractable Split Flap. Thomas A. Harris and Paul E. Purser. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-317)*, March, 1941. 21 pp., figs. 10 references.

Electrical Equipment

Precision Snap-Acting Switches. I. A. L. Riche. *Product Engineering*, Vol. 18, No. 2, February, 1947, pp. 135–140, illus.

The principles of operation, operating characteristics, and electrical and mechanical application factors for aircraft and instrument uses.

Some Design Considerations for Electrical Contact Operation. R. B. Immel. *Product Engineering*, Vol. 18, No. 2, February, 1947, pp. 107–109, 112, illus.

The causes of arcing, the proper design for best operation, and the characteristics of contact materials. The design and performance of three different contact assemblies are compared.

DVL Plasticity Testing Device (PPG-2) to Determine the Deformation of Electric Cable Insulations Under Pressure and Heat. H. Viehmann. *(Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/855*, August, 1937.) *U.S., Army Air Forces, Translation No. F-TS-1062-RE*, February, 1947. 8 pp., illus.

Engine Parts and Accessories

Electronic Ignition System in Experimental Stage. Alfred J. Poole. *Automotive and Aviation Industries*, Vol. 96, No. 3, February 1, 1947, pp. 37, 90, figs.

An electronic ignition system produced experimentally by the Bosch firm in Germany during the latter part of the war is claimed to eliminate many of the deficiencies of a conventional magneto system. Basically, the circuit involves a condenser, serving as an accumulator, charged through a resistance and discharged through a grid-controlled tube to the primary of the high-tension spark plug. After completion of the discharge, the grid voltage prevents further passage of current between the anode and cathode of the tube, and the condenser charge is again built up. Special gas-filled tubes are used in the system.

Lifting the Secrecy Lid on Bendix System of Direct Fuel Injection. Joseph Geschelin. *Automotive and Aviation Industries*, Vol. 96, No. 3, February 1, 1947, pp. 28, 29, 64, 67, illus.

The Bendix fuel-injection system was developed for A.A.F. use during the war in high-output, multiple-bank, radial aircraft engines operating at substratosphere altitudes and is now available for commercial aircraft. The main element of the system is the injection pump which divides fuel received from a master control unit into equal parts, and delivers these to the engine cylinders at timed intervals and at high pressure through discharge nozzles in the cylinder heads. With this method, the air and fuel are controlled separately, and are not mixed until they meet in the combustion chamber of the cylinder. The master control unit meters the fuel in the exact quantity required for the conditions of engine speed, load, and altitude.

Performance Characteristics of Journal Bearings with Forced-Feed Lubrication. S. A. McKee, H. S. White, A. D. Bell, and J. F. Swindells. *U.S., N.A.C.A., Advance Restricted Report No. 4H15 (Wartime Report No. W-54)*, August, 1944. 33 pp., illus. 2 references.

Load-Carrying Capacity of Journal Bearings. J. M. Stone and A. F. Underwood. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 56–67, Discussion, pp. 67–70, figs. 13 references.

Dynamically loaded bearings on which the load alternates or rotates in direction and on which the load intensity is constant or varies are discussed. The relative load-carrying capacity of a finite-length bearing with thick film lubrication is shown to be proportional to the expression: (2×load r.p.m.—journal r.p.m.), in which the journal is rotating at a uniform speed and the load, which is constant in magnitude, is rotating at some other uniform speed called "load r.p.m." The test setup used to prove the formula is described. Oscillograms are presented which show the change in oil-film thickness as the load conditions are varied. A method for investigating the capacity of engine bearings is also discussed. It is shown that the value for a connecting-rod bearing varies from zero to ten times the load that a turbine-type bearing will stand.

Aluminum Alloys for Bearings. H. Y. Hunsicker and L. W. Kempf. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 6–26, illus. 29 references.

After testing a number of aluminum alloys for antiscoring qualities, fatigue resistance, and mechanical stability in operation, the optimum bearing characteristics were found in alloys having a plastic, low-melting phase and a relatively hard phase uniformly distributed throughout an aluminum solid solution matrix of moderate hardness. Tin, affording ease in alloying and resistance to corrosion in lubricating oils, furnishes the best plastic constituent. The addition of silicon forms a hard constituent that increases strength markedly. Antiscuffing qualities are improved also, although ductility is reduced. An aluminum-tin-silicon-copper alloy was found to be the most successful aluminum bearing alloy yet developed. It was intended for permanent-mold castings but may be used in centrifugal castings for large-sized bearings or in pressure die castings and sheet for small thin-walled bearings. Manufacturing costs are low because of good machining characteristics.

Turbosupercharger-Rotor Temperatures in Flight. Edward R. Bartoo. *U.S., N.A.C.A., Technical Note No. 1159*, October, 1946. 22 pp., illus. 1 reference.

Temperatures were measured for a variety of conditions by thermocouples, the leads of which were brought from the turbine by means of rotating slip rings and stationary brushes. A consistent and almost linear relation was shown between turbine temperature at the outer edge of the rim and the effective exhaust-gas temperature at the surfaces of the blades on three successive flights at cruising power. Similar, but not so well defined, variations were obtained at two other power conditions. During flights at numerous power conditions, turbine temperatures varied widely and no acceptable method of correlation could be determined. It was estimated that the maximum temperature at the rim of the rotor at rated altitude would be approximately 1,175°F. for this particular installation.

Effects on Performance of Changing the Division of Work Between Increase of Angular Velocity and Increase of Radius of Rotation in an Impeller. Ambrose Ginsburg, William K. Ritter, and John Palasics. *U.S., N.A.C.A., Technical Note No. 1216*, February, 1947. 27 pp., illus. 8 references.

The effect on the performance of increasing the angular velocity of an impeller and consequently increasing the amount of work of compression resulting from the angular acceleration of the air in the impeller was investigated for four impellers in combination with a vaneless diffuser in a variable-component supercharger test rig over a range of actual tip speeds from 800 to 1,300 ft. per sec. The impeller adiabatic efficiency, pressure coefficient, and volume-flow capacity were improved when the amount of work resulting from the angular acceleration was increased with respect to the work of compression resulting from the increased radius of rotation of the impeller.

Performance of Hoods for Aircraft Exhaust-Gas Turbines. L. Richard Turner, Warren H. Lowdermilk, and Albert M. Lord. *U.S., N.A.C.A., Technical Note No. 1149*, November, 1946. 62 pp., figs. 1 reference.

The performance of a turbosupercharger turbine was measured with three types of exhaust hood. The effectiveness of the turbine-hood combination was determined by measuring the turbine power and the thrust of the jet discharged from the hood at pressure ratios across the turbine and hood of 1.35, 1.7, and 2.0 for a range of blade-to-jet speed ratios from 0.1 to 0.9. Compressed air was used as the driving fluid. The results of these tests indicate that an exhaust hood should have an inlet area equal to the bucket-annulus area of the turbine and should be equipped with straightening vanes. A system of vanes, the total chord of which was equal to the turbine pitch-line circumference, achieved complete straightening of the flow and reduced losses due to swirl. The flat-nozzle hood, which was designed to guide the gas from the round bucket-annulus section into a flat duct, imposed no greater losses than the best conical hood. The turning of high-velocity flow in a flat duct led to extremely large losses. A conventional short-turning-radius hood was found to give larger losses than the vaned-conical and flat-nozzle hoods.

Thread-Rolled Cooling Fins: German Process for Producing Radiator Elements from Seamless Tube. *(F.I.A.T. Report No.*

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582.) *Aircraft Production*, Vol. 9, No. 100, February, 1947, p. 76, fig. (Abstract.)

The Effect of Spinner-Body Gap on the Pressures Available for Cooling in the NACA E-Type Cowling. John V. Becker and Axel T. Mattson. *U.S., N.A.C.A., Confidential Bulletin (Wartime Report No. L-497)*, March, 1943. 11 pp., illus. 4 references.

Tests of Propeller-Speed Cooling Blowers. Abe Silverstein. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-455)*, July, 1942. 13 pp., illus. 1 reference.

The Design of Cooling Ducts with Special Reference to the Boundary Layer at the Inlet. S. Katzoff. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-321)*, December, 1940. 16 pp., figs. 3 references.

The Effect of Valve Clearance on Knock-Limited Performance and Engine Cooling. Harvey A. Cook, Paul H. Richard, and Kenneth D. Brown. *U.S., N.A.C.A., Memorandum Report No. E5D18 (Wartime Report No. E-189)*, April, 1945. 16 pp., figs. 1 reference.

Process of Lead-Deposit Accumulations on Aircraft-Engine Spark Plugs. J. L. Sloop, George R. Kinney, and William H. Rowe. *U.S., N.A.C.A., Memorandum Report No. E5 K29 (Wartime Report No. E-181)*, December, 1945. 12 pp., illus. 1 reference.

Effect in Flight of the Propeller Cuffs and Spinner on Pressure Recovery in Front of a Double-Row Radial Aircraft Engine in a Twin-Engine Airplane. Carl Ellisman. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-169)*, March, 1944. 15 pp., illus. 1 reference.

The Effect of External Shape upon the Drag of a Scoop. Irven Naiman and Paul R. Hill. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-331)*, July, 1941. 32 pp., illus. 4 references.

Apparatus for the Testing of Piston Rings. A. Tenot. (*Mécanique*, Vol. 30, No. 337, September, 1946, pp. 213–217.) *The Engineers' Digest*, Vol. 4, No. 1, January, 1947, pp. 37, 38, illus. (Extended abstract of a paper.)

Tests with apparatus developed by the Swiss firm of A. J. Amsler showed a better approximation to actual service conditions than earlier methods. The piston ring to be tested is compressed or expanded by the application of a true flexing couple that is uniform over the entire circumference of the ring except for the short portions projecting beyond the points of application. The forces necessary to produce the couple are set up by hand, the couple itself being measured by means of a torsion bar forming part of the equipment. A simple formula permits computation of the magnitude of the couple required to produce a deformation equal to that caused by a uniformly distributed pressure under actual operating conditions.

A Study of Piston and Ring Friction. W. A. Leary and J. U. Jovellanos. *U.S., N.A.C.A., Advance Restricted Report No. 4J06 (Wartime Report No. W-47)*, November, 1944. 71 pp., illus. 3 references.

Operating Stresses in Aircraft-Engine Crankshafts and Connecting Rods. I—Slip-Ring and Brush Combinations for Dynamic-Strain Measurements. Francis J. Dutee, Franklyn W. Phillips, and Richard H. Kemp. *U.S., N.A.C.A., Memorandum Report No. E5C30 (Wartime Report No. E-187)*, March, 1945. 23 pp., illus. 1 reference.

Welded Magnesium Tanks. II—Structure-Design for Butt Welding: Fitting of Ancillary Components: Precautions Against Corrosion. R. J. Cross. *Aircraft Production*, Vol. 9, No. 100, February, 1947, pp. 71–75, illus.

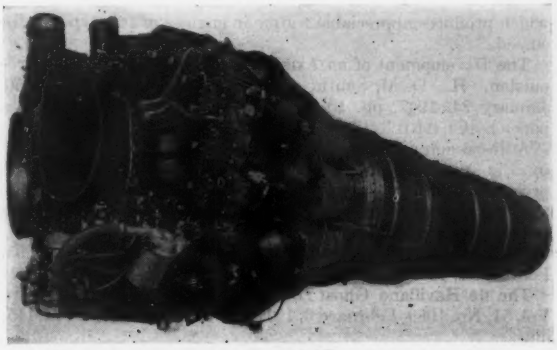
Some detailed aspects of magnesium tank design are discussed, with particular reference to fulfillment of load requirements, ease of production by welding, and accommodation of accessories.

Mechanical Seals. Carl E. Schmitz. *Lubrication Engineering*, Vol. 2, No. 4, December, 1946, pp. 162–165, illus.

A Laboratory-Tested Constant-Level Oil Sump to Prevent Aeration of Scavenged Oil from an Aircraft Engine. I. Irving Pinkel and Howard D. Plumly. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-182)*, April, 1944. 8 pp., figs.

Air and Oil Filtration. I. *Aircraft Production*, Vol. 9, No. 100, February, 1947, pp. 57–62, illus.

The theory of filtration and the design features of filters produced by Vokes Ltd. (England), for aircraft and other purposes, are discussed. The laboratory equipment used and the tests carried out in connection with the investigation are described.



The de Havilland Ghost gas turbine engine is only 53 in. in diameter, but it develops static thrust of 5,000 lbs.

Engines—General

On Combustion in a Turbulent Flow. K. I. Shelkin. (*Zhurnal Tekhnicheskoi Fiziki (U.S.S.R.)*, Vol. 13, No. 9-10, 1943.) *U.S., N.A.C.A., Technical Memorandum No. 1110*, February, 1947. 16 pp., figs. 6 references.

The characteristics introduced by turbulence in the process of flame propagation are considered. On the basis of geometric and dimensional considerations an expression is obtained for the velocity of the flame propagation in a flow of large scale of turbulence. The data on the measurement of the flame speeds of various fuels in the engine and the measurement of the dependence of the flame speed on the rotational speed confirm the theoretic conclusions, if it is assumed that the increase in the combustion rate in the engine is determined by the turbulence.

Power Installations. F. M. Owner. *The Royal Aeronautical Society, Journal*, Vol. 51, No. 434, February, 1947, pp. 71–105, Discussion, pp. 105–108, illus. 24 references. (Cf. AER 3/47: 57.)

Engines, Gas Turbine

Aviation Gas Turbine Fuels. W. J. Sweeney, A. J. Blackwood, and W. R. F. Guyer. *Paper presented at I.A.S. National Aircraft Propulsion Meeting*, Cleveland, March 28, 1947. (For abstract see "I.A.S. Briefs" on page 30 of this issue, April, 1947.)

N.A.C.A. Cascade Data for the Blade Design of High-Performance Axial-Flow Compressors. S. M. Bogdonoff. *Paper presented at I.A.S. National Aircraft Propulsion Meeting*, Cleveland, March 28, 1947. (For abstract see "I.A.S. Briefs" on page 30 of this issue, April, 1947.)

A New Method for the Aerodynamic Design of Multistage Axial Flow Compressors. Hunt Davis. *Paper presented at I.A.S. National Aircraft Propulsion Meeting*, Cleveland, March 28, 1947. (For abstract see "I.A.S. Briefs" on page 29 of this issue, April, 1947.)

Bases of Comparison of Jet Propulsion Units. O. Lutz. (*Luftfahrtforschungsanstalt Hermann Göring*, February, 1940.) *U.S., Army Air Forces, Translation No. F-TS-682-RE*, November, 1946. 36 pp., figs.

Basic relations are derived for the comparison of jet propulsion units from the standpoint of efficiency, in which certain coefficients are proposed and defined, and fundamental limits imposed by nature are pointed out. The unit is studied on the test stand and in flight, and an evaluation is made of the efficiency of the basic thermodynamic cyclic process. Definitions for the efficiency of jet power plants are proposed.

Automatic Controls for Gas Turbines. C. W. Chillson, G. P. Knapp, and M. Meyer. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 68–70, figs. (Extended abstract of a paper: Automatic Control Considerations for Aircraft Gas Turbine-Propeller Powerplants.)

The control problem in turbopropeller power plants is not simple because of the large number of variables for both power plant and propeller which must be considered. The operating requirements and the variables to be controlled are defined and analyzed. The problem of overcoming the effects of windmilling,

which produces appreciable torque in engines of this type, is discussed.

The Development of an Axial Flow Gas Turbine for Jet Propulsion. II. D. M. Smith. *The Engineer*, Vol. 183, No. 4750, January 24, 1947, pp. 105–107, illus. (Extended abstract of a paper.) (Cf. AER 3/47:58.)

A discussion of development work on gas turbines carried out by the Metropolitan-Vickers Electrical Co., Ltd. deals with progress in the design of F2 compressors, combustion chambers, turbine components, and the fuel system. Brief remarks about the flight-testing of F2 engines are included.

The de Havilland Ghost. *The Aeroplane*, Vol. 72, No. 1863, February 7, 1947, pp. 158–164, illus.

The de Havilland Ghost (DGT/50). F. C. Sheffield. *Flight*, Vol. 51, No. 1989, February 6, 1947, pp. 142, 142a, 142b, 143–145, illus.

Some Aspects of Gas Turbine Development. S. G. Hooker. *North East Coast Institution of Engineers and Shipbuilding, Transactions*, Vol. 62, 1946, pp. 143–156, figs., Discussion, pp. D47–D74, illus. (Reprint.)

The relation of the performance of the Rolls-Royce Derwent V. jet propulsion engine to the equivalent piston-engine performance is analyzed. The problem of examining the thermodynamic arrangements of gas-turbine engines is simplified by considering the basic engine as a producer of hot gas under pressure. The effect of compression ratio, flame temperature, heat exchangers, and intercooling on the performance of a unit is examined. Compression ratio between 6:1 and 7:1 appears to be optimum with existing compressor knowledge, and gain in thermal efficiency for combustion temperatures above 1,100° Kelvin is rapidly diminishing. Heat exchangers have an important effect on thermal efficiency but intercooling merely affects the power output. A brief account of some properties of modern materials is given and the results of a number of engine and rig tests on turbine discs are set forth. Turbine-blade stresses, the compactness of a gas turbine for a given power output, and its other mechanical advantages are stressed.

A Novel Gas Turbine. *Aeronautics*, Vol. 16, No. 1, February, 1947, p. 36.

A gas turbine having a rotor constructed with tapered tubes instead of blades has been patented by R. F. James. It is claimed this would make possible small depth so that the engine could be installed within the aircraft wing.

These Test Procedures Keyed Jet Engine Advance. E. E. Stoeckly. *Aviation*, Vol. 46, No. 2, February, 1947, pp. 46–48, figs.

Some of the tests on gas-turbine engines and components have a counterpart in reciprocating-engine testing but many are entirely different because of the new problems encountered. Details are given about tests to prove mechanical strength and endurance, and those to determine thermodynamic performance.

Turbo-Prop Enters Air Transport Race. F. W. Kolk. *SAE Journal*, Vol. 55, No. 2, February, 1947, pp. 80, 81, fig. (Abstract of a paper: The Future of the Gas Turbine in Air Transportation.)

Axial-Flow Gas Turbine Development. *The Aeroplane*, Vol. 72, No. 1861, January 24, 1947, pp. 98, 99. (Extended abstracts of 2 papers: The Technical Development of the Metropolitan-Vickers F-2 Jet-Propulsion Engine, D. M. Smith. The Practical Aspects of Cascade Wind-Tunnel Research, K. W. Todd.)

Engines, Ram-Jet

Aero-Thermodynamic Study of Ram-Jet Propulsion. Boleslaw Szczeniowski. *École Polytechnique (University of Montreal)*. (For abstract see "I.A.S. Briefs" on page 31 of this issue, April, 1947.)

Engines, Reciprocating

Factors Producing Erratic Engine Operation. A. Lewis MacClain. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 28–55, 86, figs. 23 references.

Erratic engine operation which cannot be blamed on mechanical, electrical, or carburetion failures may be due to the fact that power plants in flight are not being operated under the same conditions of warm air, warm engine, and warm carburetor air used during development and determination of carburetor settings. The lack of heat results in the inadequate preparation of the fuel for combustion. Material is presented which will provide a fundamental background for analysis connected with obtaining the proper fuel-air ratios under various operating conditions, the handling of fuel in the fuel tanks and fuel system, icing problems, and the use of water injection.

Roles of Detonation Waves and Autoignition in Spark-Ignition Engine Knock as Shown by Photographs Taken at 40,000 and 200,000 Frames Per Sec. Cearcy D. Miller. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 98–143, illus. 73 references.

A study of photographs made by the N.A.C.A. provides convincing evidence that knock in spark-ignition engines is best explained by a combination of the deterioration-wave and autoignition theories. The indications are that knock is actually caused by the detonation wave that follows autoignition of the gas. The results of many earlier research programs favor the combined theory.

Oxygen Boost of Engine Power at Altitude. Francis Masi, Ernest F. Flock, and Robert A. Grosselfinger. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 76–86, figs.

Summary of an investigation carried out by the Bureau of Aeronautics, Navy Department. The use of liquid-oxygen injection for limited periods in nonservice installations has increased the speed, rate of climb, and operational ceiling without increasing the tendency toward knocking. A system weighing 180 lbs., including about 100 lbs. of oxygen, will increase the power of an R-2800 engine by 300 hp. for 16 min. Maximum permissible boost is limited by engine cooling.

The Viscous Torsional Vibration Damper. Bernard E. O'Connor. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 87–97, figs.

The theory of the untuned viscous damper is developed mathematically to show that its characteristics are such as to make practical the use of silicone fluid as a damping medium. That this type of damper achieves a high relative efficiency throughout a wide range of damping is indicated by a consideration of a simple mass system. The performance of a damper applied to the mass elastic system of a typical six-cylinder gasoline engine is predicted to be satisfactory over a range of speeds and values of the damping constant. An exact tabular method and a simpler approximate method are proposed for calculating the maximum amplitude and the frequency at which it occurs.

A Method for the Design of Cooling Systems for Aircraft Power-Plant Installations. Kennedy F. Rubert and George S. Knopf. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-491)*, March, 1942. 25 pp., figs. 10 references.

German Diesel-Engine Development. C. G. A. Rosen. *SAE Quarterly Transactions*, Vol. 1, No. 1, January, 1947, pp. 144–160, illus. Although this summary is particularly concerned with naval installations, some data on engines for aircraft uses are included.

Universal Power Plants. *Flight*, Vol. 51, No. 1990, February 13, 1947, pp. 157–162, illus.

A review of Rolls-Royce universal power plants provides a picture of the research work and development that has resulted in engines equipped to meet almost every climatic emergency and capable of long running periods before overhaul. The use of such interchangeable power plants makes it possible to take airplanes out of service for only a few hours for power-plant change. The types of Rolls-Royce universal power plants are listed, together with the aircraft for which they are intended. Particular attention is given to the design of the Merlin engine for the Canadian Douglas DC-4M.

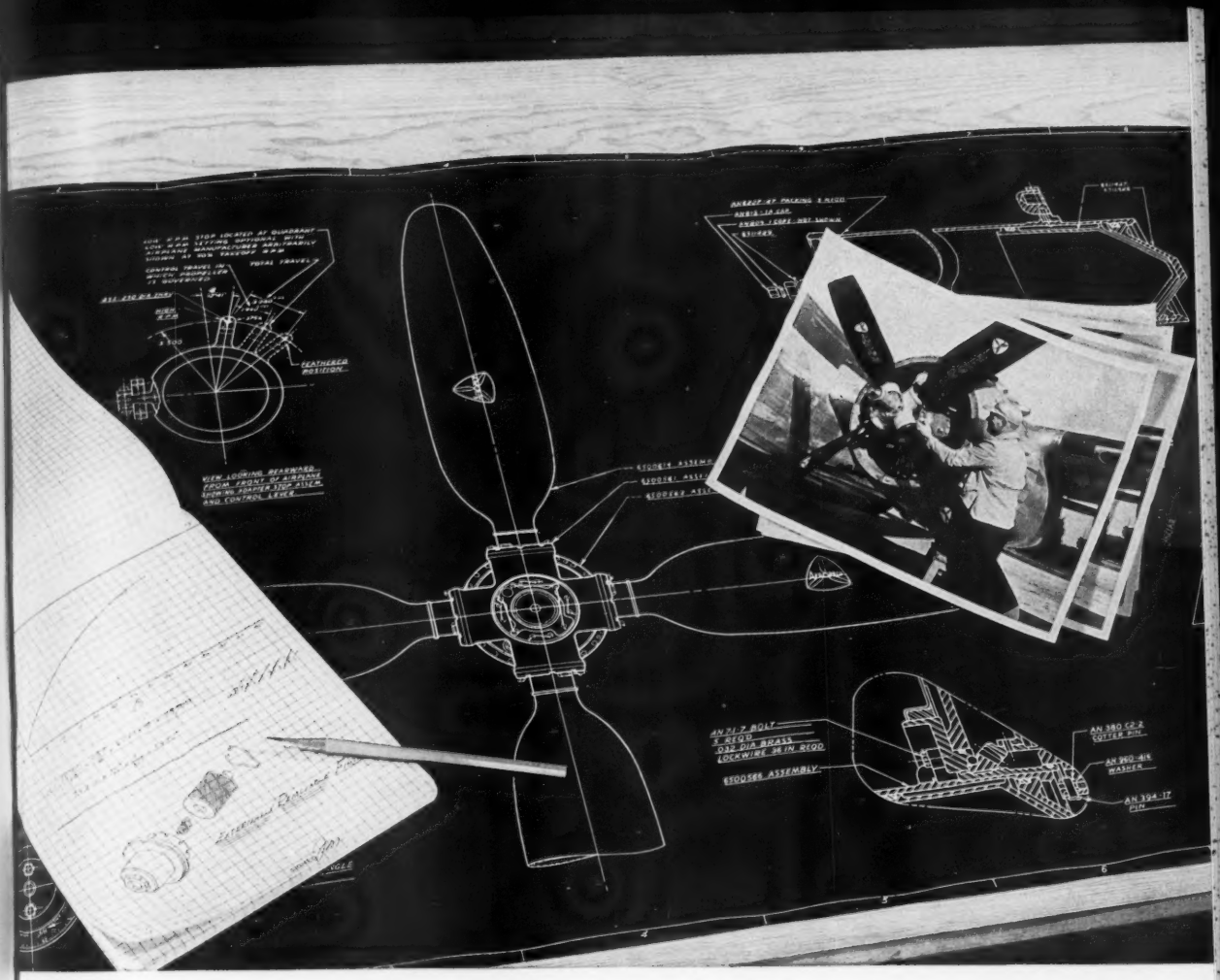
Soviet Aircraft Engines. *Flight*, Vol. 51. No. 1987, January 23, 1947, pp. 86, 87, table. Details of representative operational types, with tabulated specifications of 18 models.

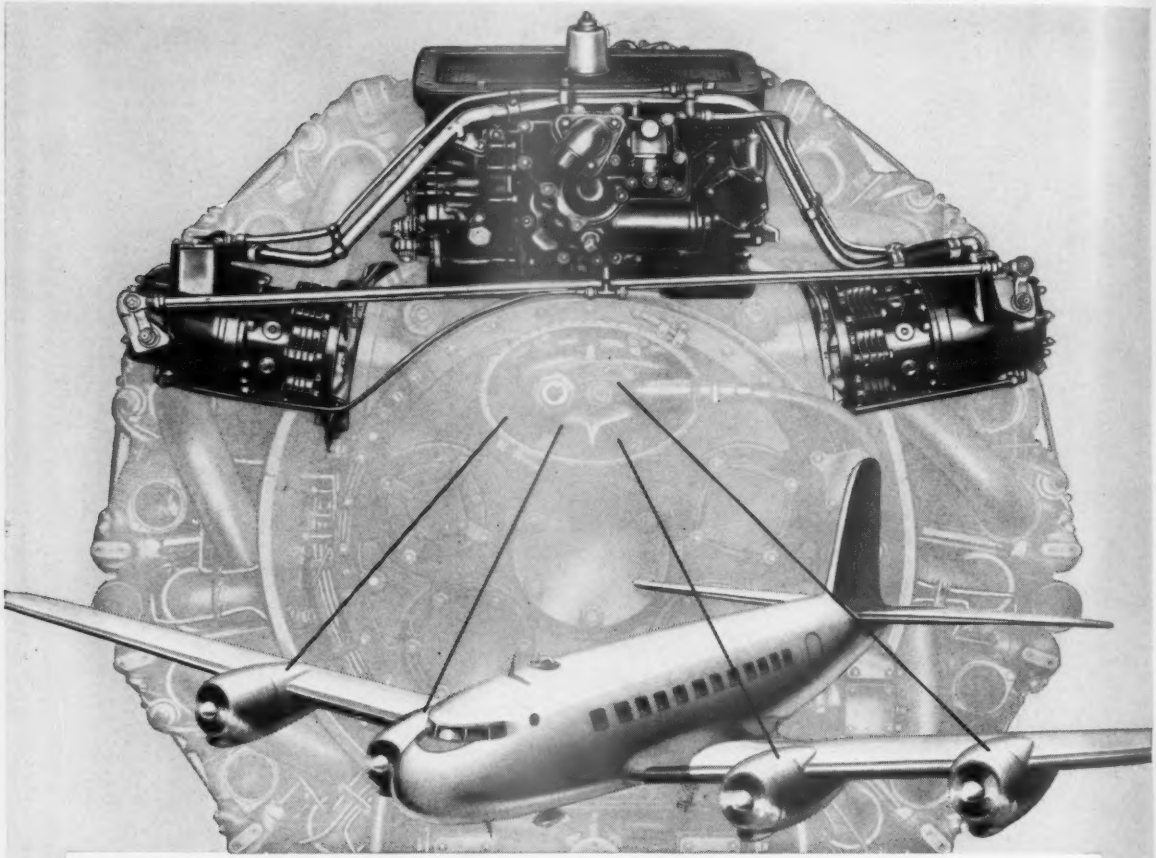
Rounding Off a Sabre. *Aeronautics*, Vol. 16, No. 1, February, 1947, pp. 28–31, illus.

How drag resulting from the radiator and oil cooler of the Napier Sabre VI-equipped Tempest and Warwick aircraft has been reduced by improved cowling and annular radiators is described. Tables give comparisons of cooling drags with annular and under-nose radiators, as determined from wind-tunnel tests of models.

Cirrus Activities. *Flight*, Vol. 51, No. 1986, January 16, 1947, p. 64, illus.

Some details of the Blackburn 180-hp. four-cylinder Bombardier, the 265-hp. six-cylinder Musketeer, and the 300-hp. Grena-


FEATHERED POSITION
VIEW LOOKING REARWARD FROM FRONT OF AIRPLANE SHOWING PROPELLER STOP ASSEM. AND CONTROL LEVER
AN 960-416 WASHER
AN 394-17 PIN



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dier. Departures from past Cirrus practice include direct fuel injection and overhead camshafts.

Symbol of Power; The New Rolls-Royce Eagle. *Flight*, Vol. 51, No. 1988, January 30, 1947, p. 116, illus. (Cf. AER 3/47:61.)

The Significance of the Time Concept in Engine Detonation. W. A. Leary and E. S. Taylor. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. W-32)*, January, 1943. 71 pp., illus. 24 references.

The Influence of Exhaust Pressure on Knock-Limited Performance. Harvey A. Cook, Louis F. Held, and Ernest I. Pritchard. *U.S., N.A.C.A., Memorandum Report No. E5A05 (Wartime Report No. E-188)*, January, 1945. 20 pp., figs. 2 references.

Engine Development Projects at Tachikawa Army Air Arsenal. T. W. Howard, Jr. *U.S., Army Air Forces, Intelligence Review No. F-IR-102-RE*, December, 1946. 41 pp., tables.

Cold Starting Characteristics of the Cyclone Engine. George A. Bleyle. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 24 pp., figs. 2 references.

Relation Between Fuel Economy and Crank Angle for the Maximum Rate of Pressure Rise. Harvey A. Cook and Virginia L. Brightwell. *U.S., N.A.C.A., Memorandum Report No. E5E21 (Wartime Report No. E-179)*, May, 1945. 11 pp., figs.

The Advantages of Uniform Fuel Distribution for Air-Cooled Engines from Considerations of Cooling Requirements and Fuel Economy. K. F. Rubert, Blake W. Corson, Jr., and Jack Nielsen. *U.S., N.A.C.A., Confidential Bulletin No. 3L07 (Wartime Report No. L-338)*, December, 1943. 13 pp., figs. 1 reference.

Engines, Rocket

Regenerative Rocket Cooling. Thomas F. Reinhardt. *Paper presented at I.A.S. National Aircraft Propulsion Meeting*, Cleveland, March 28, 1947. (For abstract see "I.A.S. Briefs" on page 31 of this issue, April, 1947.)

The Problem of Escape from the Earth by Rocket. Martin Summerfield and F. J. Malina. *California Institute of Technology.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, April, 1947.)

The Evolution of Energy in Jet and Rocket Propulsion. VI. P. Bielkowicz. *Aircraft Engineering*, Vol. 19, No. 215, January, 1947, pp. 19–23, 26, figs. 16 references. (Cf. AER 3/47:63.)

A discussion of problems including the actual combustion processes, the nature of the flame, and its speed of propagation. A source of divergence between theoretic and experimental data is the dissociation of the molecules and the amount of energy absorbed by the dissociation. The speed of propagation of the flame front depends upon initial temperature and pressure of the mixture, its mean specific heat, and thermal conductivity. Problems connected with carbon monoxide combustion are examined.

On the Thermodynamics of Rocket Propulsion. I. K. Schaefer. (*Deutsche Luftfahrtforschung, ZWB/UM/Re/847*, December, 1944.) *U.S., Army Air Forces, Translation No. F-TS-982-RE*, February, 1947. 7 pp. 2 references.

An estimate is made of the extent to which dissociation equilibrium is established during the outflow from the thrust nozzle of a rocket drive. It is shown that the establishment of the equilibrium may be assumed for this case, based on accuracy of temperature determination which is obtainable with the present-day knowledge of calorific data.

The Initial Acceleration of a Rocket. Derek F. Lawden. *British Interplanetary Society, Bulletin*, Vol. 2, No. 2, February, 1947, pp. 25–27, figs. A mathematical approximation, neglecting air resistance and rotation of the earth.

The Problem of Interplanetary Propulsion. L. R. Shepherd. *The Engineers' Digest*, Vol. 4, No. 1, January, 1947, pp. 25–28. (See AER 1/47:48.)

Working Formulae. R. A. Smith and H. E. Ross. *British Interplanetary Society, Bulletin*, Vol. 2, No. 2, February, 1947, pp. 34–37.

Twelve formulas for obtaining a first-order approximation of fuel efficiency, the effect of gravitational fields, and orbital velocities.

DC-4 Payload—Not Much in the Andes. *American Aviation*, Vol. 10, No. 16, February 15, 1947, p. 57, table.

The Aerojet Engineering Corporation has made a study of airports in the Andes to determine how effectively jet assistance could be used to provide necessary take-off power at high altitudes. Data for a standard Douglas C-54-E-DC airplane are presented.

Fire Prevention

DC-6 Conforms to New Fire-Prevention Regulations. I. J. Hammill. *Walter Kidde & Co., Inc.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, April, 1947.)

Fire Factors in Aircraft Accidents. II. George H. Tryon, III. *Air-Sea Safety*, Vol. 2, No. 2, February, 1947, pp. 15–20, illus. (Cf. AER 3/47:63.)

Fire factors discussed include aeronautical-design fire prevention (including operational features); aeronautical fire-protection facilities; aircraft-maintenance fire hazards; aircraft-storage fire hazards; airdrome fire protection; and aircraft fire fighting.

Lightplane Anti-Fire Unit Means Extra Safety. *Aviation*, Vol. 46, No. 2, February, 1947, p. 111, illus.

A carbon dioxide fire extinguishing system has been specially designed for the Ercoupe by Walter Kidde & Company. It contains about 20 lbs. of liquid CO_2 under pressure, a pull release handle, and piping leading to strategic spots in the engine compartment.

Flight Technique

Refuelling of Aircraft in Flight; An Answer to the Problem of High Wing-Loadings. *Modern Transport*, Vol. 56, No. 1452, January 11, 1947, pp. 3, 7, illus.

Methods of refueling aircraft in flight are discussed, with particular reference to a system evolved by Flight Refueling, Ltd.

Strange Field Landings. Harold G. Crowley. *U.S., Civil Aeronautics Board, Safety Bulletin No. 176-47*, February 1, 1947. 4 pp. Govt. Printing Office, Washington. $0.05.

Flight Testing and Performance

Research Studies Directed Toward the Development of Rational Vertical-Tail-Load Criteria. Lawrence A. Clousing. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 175–182, figs. 6 references.

Vertical-tail-load criteria should be more closely related to the stability and control characteristics of the airplane. For the purpose of flight verification of methods of computing the loads, measurement of sideslip angle and rudder angle rather than vertical tail load may provide sufficient information for a check of the essential parts of the methods of computing load. Three maneuvers are discussed as being possible to use as a basis for specifications for the computation of critical vertical tail loads. These maneuvers are the rolling pull-out maneuver, the steady sideslip, and the fish-tail maneuver. For each maneuver, information on methods of computation of load is presented and a comparison is made with the results of flight tests. The possible relation of each maneuver to the critical load distribution is discussed.

Simple Analytical Equations for the Velocity of an Airplane in Unaccelerated Level, Climbing, and Diving Flight. Hugh B. Freeman. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 185–189, figs.

The difficulty of expressing the performance of an airplane analytically stems partly from the complexity of the equations resulting when power is introduced into the analysis prematurely. If the thrust is used instead of power, extremely simple analytical equations result. From these equations the power relationships follow quite simply. It is shown that the velocity of an airplane in unaccelerated flight may be expressed as a simple function of the thrust and two constants of the airplane; the parasite area and the thrust corresponding to the configuration for maximum lift-drag ratio. For level flight the equation for the velocity is set forth, and a simple method of solving it is presented. The conventional thrust horsepower required curves are obtained following the solution of this equation by the simple process of multiplication. Similar equations are derived for the conditions of unaccelerated climb and diving flight.

Rate of Roll of Aeroplanes. William T. Thomson. *Aircraft Engineering*, Vol. 19, No. 215, January, 1947, pp. 18, 26, figs. 6 references.

Much of the previous investigation of elastic deformation of the wing in relation to divergence and loss of aileron control has been based on the equivalent two-dimensional wing, the success of which depends on the proper choice of a representative wing section. The three-dimensional analysis requires a knowledge of the torsional deflection mode, which in general necessitates an iteration process for evaluation. It is shown in an investigation of the theoretic rate of roll of an airplane considering a three-dimensional wing, that considerable simplification results from assuming the normal mode in torsion to be independent of speed. The rate of roll may then be expressed in a simple form in terms of the reversal and divergence speeds, both of which are assumed to be known.

Formulas for Additional-Mass Corrections to the Moments of Inertia of Airplanes. Frank S. Malvestuto, Jr., and Lawrence J. Gale. *U.S., N.A.C.A., Technical Note No. 1187*, February, 1947. 28 pp., figs. 6 references.

In order to obtain the true moments of inertia of the model or airplane the experimental moments of inertia, determined by the pendulum method, must be corrected for the effect of the surrounding air. The effect of this ambient air on the apparent moments of inertia is usually small but may be as large as 25 per cent of the true moments of inertia for airplanes with low wing loading. Formulas are presented which are of particular value in converting the virtual moments of inertia of airplanes or models experimentally determined in air to the true moments of inertia. A correlation of additional moments of inertia calculated by these formulas with experimental additional moments of inertia obtained from vacuum-chamber tests of 40 spin-tunnel models indicates that the formulas give satisfactory estimations of the additional moments of inertia.

High-Speed Tests on the He-162 Jet Fighter. H. Lindemann. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/UM/1479*, February, 1945.) *U.S., Army Air Forces, Translation No. F-TS-1037-RE*, February, 1947.

Report on first three-component tests of a model He 162 run in the DVL high-speed wind tunnel. Measurements showed unfavorable behavior with regard to the longitudinal moment because of the low position of the horizontal tail.

Wind-Tunnel Procedure for Determination of Critical Stability and Control Characteristics of Airplanes. Harry J. Goett, Roy P. Jackson, and Steven E. Belsley. *U.S., N.A.C.A., Advance Restricted Report No. 4D29* (*Wartime Report No. W-5*), April, 1944. 26 pp., figs. 6 references.

A Theoretical Investigation of Longitudinal Stability of Airplanes with Free Controls Including Effect of Friction in Control System. Harry Greenberg and Leonard Sternfield. *U.S., N.A.C.A., Advance Restricted Report No. 4B01* (*Wartime Report No. L-430*), February, 1944. 51 pp., figs. 1 reference.

Analysis of Wind-Tunnel Stability and Control Tests in Terms of Flying Qualities of Full-Scale Airplanes. Gerald G. Kayten. *U.S., N.A.C.A., Advance Restricted Report No. 3J22* (*Wartime Report No. L-322*), October, 1943. 59 pp., figs. 14 references.

Effect of Wing Loading and Altitude on Lateral Stability and Control Characteristics of an Airplane as Determined by Tests of a Model in the Free-Flight Tunnel. John P. Campbell and Charles L. Seacord, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 3F25* (*Wartime Report No. L-522*), June, 1943. 21 pp., figs. 5 references.

Some Theoretical Considerations of Longitudinal Stability in Power-On Flight with Special Reference to Wind-Tunnel Testing. Charles J. Donlan. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-309*), November, 1942. 24 pp., figs. 3 references.

Calculated Effects of Full-Span Slotted and Fowler Flaps on Longitudinal Stability and Control Characteristics for a Typical Fighter-Type Airplane with Various Tail Modifications. R. Fabian Goranson. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-392*), July, 1942. 11 pp., figs. 5 references.

Wind-Tunnel Investigation of Effect of Yaw on Lateral-Stability Characteristics. IV—Symmetrically Tapered Wing with a Circular Fuselage Having a Wedge-Shaped Rear and a Vertical Tail. I. G. Recant and Arthur R. Wallace. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-520*), March, 1942. 24 pp., figs. 8 references.

A Theoretical Analysis of the Effect of Aileron Inertia and Hinge Moment on the Maximum Rolling Acceleration of Airplanes in Abrupt Aileron Rolls. F. J. Bailey, Jr., and William J. O'Sullivan. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-302*), February, 1942. 16 pp., figs.

A Theoretical Investigation of the Rolling Oscillations of an Airplane with Ailerons Free. Doris Cohen. *U.S., N.A.C.A., Advance Restricted Report No. 4A06* (*Wartime Report No. L-381*), January, 1944. 37 pp., figs. 7 references.

A Theoretical Investigation of the Lateral Oscillations of an Airplane with Free Rudder with Special Reference to the Effect of Friction. Harry Greenberg and Leonard Sternfield. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-394*), March, 1943. 36 pp., figs. 5 references.

A Flight Investigation of Short-Period Longitudinal Oscillations of an Airplane with Free Elevator. William H. Phillips. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-444*), May, 1942. 21 pp., illus. 2 references.

The Effect of Spanwise Mass Distribution upon the Spin Characteristics of Airplanes as Determined by Model Tests Conducted in the Free-Spinning Wind Tunnel. Robert W. Kamm. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-351*), August, 1942. 28 pp., illus. 4 references.

Aerodynamic Factors Affecting the Ability of a Pilot to Return an Airplane to Level from a Banked Attitude by Use of the Rudder Alone and Without Change of Heading. S. M. Harmon. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-365*), October, 1941. 11 pp., figs. 2 references.

Effect of Wing Leading-Edge Slots on the Spin and Recovery Characteristics of Airplanes. Anshal I. Neihouse and Marvin Pitkin. *U.S., N.A.C.A., Advance Restricted Report No. 3D29* (*Wartime Report No. L-504*), April, 1943. 16 pp., illus. 7 references.

A Semi-Rational Criterion for Unsymmetrical Gust Loads. Richard V. Rhode and Henry A. Pearson. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-418*), August, 1941. 27 pp., figs. 4 references.

An Analytical Study of Wing and Tail Loads Associated with an Elevator Deflection. H. A. Pearson and J. B. Garvin. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-443*), June, 1941. 27 pp., figs. 8 references.

Time-Velocity-Altitude Relations for an Airplane Diving in a Standard Atmosphere. H. A. Pearson. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-291*), March, 1943. 31 pp., figs. 12 references.

Calculation of Tab Characteristics for Flight Conditions from Wind-Tunnel Data. Richard I. Sears. *U.S., N.A.C.A., Restricted Bulletin* (*Wartime Report No. L-218*), April, 1942. 5 pp., fig. 2 references.

NACA Procedure for Flight Tests of Aileron Characteristics of Airplanes. Harold I. Johnson. *U.S., N.A.C.A., Restricted Bulletin No. 3G24* (*Wartime Report No. L-265*), July, 1943. 8 pp. 1 reference.

Fuels

Flight Variables Affecting Fuel-Vapor Loss from a Fuel Tank. Charles S. Stone, Sol Baker, and Dugald O. Black. *U.S., N.A.C.A., Memorandum Report No. E4L28* (*Wartime Report No. E-186*), December, 1944. 35 pp., figs. 2 references.

Reduction of Fuel-Vapor Loss by Omitting Some of the Fuel Constituents Normally Lost During Flight. Charles S. Stone and Walter E. Kramer. *U.S., N.A.C.A., Memorandum Report No. E5H27* (*Wartime Report No. E-184*), August, 1945. 21 pp., illus. 4 references.

Analysis and Correlation of Data Obtained by Six Laboratories on Fuel-Vapor Loss from Fuel Tanks During Simulated Flight. Charles S. Stone, Sol Baker, and Gerald W. Englert. *U.S., N.A.C.A., Memorandum Report No. E4L19* (*Wartime Report No. E-185*), December, 1944. 40 pp., figs.

Motor Fuels for Light Planes? Robert V. Kerley. *SAE Journal*, Vol. 55, No. 2, February, 1947, p. 65. (Abstract of a paper: Light Aircraft Service Experience with All-Purpose Fuel.)

Investigation of Naphthalene as a Possible Aircraft Fuel. Dana W. Lee and Alois Krsek, Jr. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-168)*, August, 1941. 26 pp., illus.

The Preparation of 2,2,4,4-Tetramethylpentane. N. L. Drake. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. W-77)*, May, 1942. 12 pp., figs.

The Effect of Ethylene Dibromide on the Knock-Limited Performance of Leaded and Nonleaded S Reference Fuel. George R. Kinney and Richard O. Niemi. *U.S., N.A.C.A., Memorandum Report No. E6B12 (Wartime Report No. E-183)*, February, 1946. 11 pp., figs. 1 reference.

The Low-Temperature Solubility of Aniline, the Toluidines, and Some of Their N-Alkyl Derivatives in Aviation Gasoline. Walter T. Olson and Richard L. Kelly. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-162)*, June, 1944. 13 pp., figs. 3 references.

Knock-Limited Performance of Six Aromatic Amines Blended with a Base Fuel in a Full-Scale Aircraft-Engine Cylinder. Anthony W. Jones, Arthur W. Bull, and Edmund R. Jonash. *U.S., N.A.C.A., Memorandum Report No. E5D04 (Wartime Report No. E-165)*, April, 1945. 16 pp., figs. 9 references.

The Effect of Six Aromatic Amines on the Preignition-Limited Performance of 28-R Aviation Fuel in a CFR Engine. Donald W. Male. *U.S., N.A.C.A., Memorandum Report No. E5E12a (Wartime Report No. E-180)*, May, 1945. 4 pp. 2 references.

Knock-Limited Performance of Blends of AN-F-28 Fuel Containing 2 Percent Aromatic Amines. I. J. Robert Branstetter. **II, III, IV(MR No. E4L21), V(MR No. E5H06).** Henry E. Alquist and Leonard K. Tower. *U.S., N.A.C.A., Memorandum Reports (Wartime Reports Nos. E-148, E-149, E-150, E-152, E-151)*, April, June, August, December, 1944, August, 1945. 37 pp., figs. 1 reference; 34 pp., figs. 2 references; 44 pp., figs. 4 references; 43 pp., figs. 6 references; 14 pp., figs. 9 references.

Suitability of 18 Aromatic Amines for Overwater Storage When Blended with Aviation Gasoline. Irving A. Goodman and J. Nelson Howard. *U.S., N.A.C.A., Memorandum Report No. E5F20a (Wartime Report No. E-166)*, June, 1945. 7 pp., tables. 3 references.

The Low-Temperature Solubility of 24 Aromatic Amines in Aviation Gasoline. Richard L. Kelly. *U.S., N.A.C.A., Memorandum Report No. E4K17 (Wartime Report No. E-164)*, November, 1944. 11 pp., figs. 6 references.

Gasoline-Water Distribution Coefficients of 27 Aromatic Amines. Walter T. Olson, Adelbert O. Tischler, and Irving A. Goodman. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-163)*, August, 1944. 15 pp., figs. 5 references.

The Low-Temperature Solubility of 42 Aromatic Amines in Aviation Gasoline. Richard L. Kelly. *U.S., N.A.C.A., Memorandum Report No. E5K09 (Wartime Report No. E-167)*, November, 1945. 13 pp., figs. 10 references.

Antiknock Effectiveness of Xylidines in Small-Scale Engines. J. Robert Branstetter and Carl L. Meyer. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-159)*, August, 1943. 15 pp., figs.

Gasoline-Water Distribution Coefficients of Xylidines. Adelbert O. Tischler, Vernon A. Slabey, and Walter T. Olson. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-154)*, June, 1943. 10 pp., figs. 2 references.

Loss of Xylidines in Overwater Storage of Xylidine-Blended Fuel. Walter T. Olson and Adelbert O. Tischler. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-161)*, March, 1944. 11 figs. 1 reference.

The Low-Temperature Solubility of Technical Xylidines in Aviation Gasoline. Walter T. Olson. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-153)*, June, 1943. 5 pp., fig.

Water Tolerance of Aviation Gasoline Containing Xylidines. Joseph Revilock and Walter T. Olson. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-155)*, July, 1943. 4 pp. 1 reference.

Gliding and Soaring

Interim Report No. 2 on the Gotha 242 Glider; Maintenance Handbook (Project No. NTE-38). W. M. Kerr. *U.S., Army Air Forces, Interim Report No. F-1M-1118B-ND*, January, 1947. 82 pp., figs.

Guided Missiles

A Summary of German Missile Control Methods. Landon P. Hill. *U.S., Army Air Forces, Summary Report No. F-SU-1115-ND*, May 8, 1946. 50 pp., figs. 6 references.

Information concerning the electrical aspects of the control of German guided missiles was assembled from reports of the interrogation of personnel and a study of documents. Methods of control were (1) the polar coordinate system in which the angle of roll and the acceleration normal to the direction of flight are controlled; (2) the Cartesian coordinate system in which the missile is guided over its trajectory by controlling the aerodynamic effect of two mutually perpendicular sets of control surfaces; and (3) differentiation of control-stick movement. Ground equipment included a computing device, various types of generators, modulators, and transmitters to send the "command" signals to the missile, and a system for locating the missiles and observing their operation. The earliest type of missile-carried receiver, a twelve-tube superheterodyne designated the E230, was perhaps the most completely engineered of the German radio control-link receivers. Descriptions and operating instructions are given for various control devices.

Attainment of a Straight-Line Trajectory for a Preset Guided Missile with Special Reference to Effect of Wind or Target Motion. Herbert S. Ribner. *U.S., N.A.C.A., Memorandum Report No. L5H21b (Wartime Report No. L-590)*, August, 1945. 11 pp., figs.

Model for Investigation of the Pilot Beam in a Propulsion Test and on the Experimental Testing Table. R. Schubert. (*Peenemünde, Heeresversuchsstelle, ZWB/PA/86/44*, September, 1940.) *U.S., Army Air Forces, Translation No. F-TS-1020-RE*, January, 1947. 5 pp. Equations of motion and tests for three degrees of freedom; lateral translation, rotation about the c.g., and rotation of the control surfaces.

Prevention of Roll of the A. IV Rocket by Means of a (Pendulum. (*Peenemünde, Heeresversuchsstelle, ZWB/PA/86/4*, May, 1939.) *U.S., Army Air Forces, Translation No. F-TS-1016-RE*, December, 1946. 3 pp., graph.

German Guided Bomb PC-1400-Kg FX-1 (FRITZ-X) (Project No. NTE-15). Robert R. Bramble, Jr. *U.S., Army Air Forces, Summary Report No. F-SU-1132-ND*, November, 1946. 23 pp., illus.

The missile is described as an armor-piercing, radio-controlled, high-angle glide bomb. It is controlled through a series of four spoilers arranged to disturb the airflow over the aerodynamic surfaces of the tail fin. Roll stabilization about the vertical axis is governed by another pair of spoilers controlled by a gyroscope. Control of the missile is effected by disturbing the rhythm of motion of the spoilers across the air stream. The missile achieved an accuracy rating of about 20 per cent in service, but it is vulnerable to jamming by radio interference. To jam the control system, as a defensive measure, it is necessary only to send out a carrier wave on the proper frequency band with amplitude modulation that is accurate in frequency to ±5 per cent.

Control of Rocket Missiles. Gifford White. *Sperryscope*, Vol. 11, No. 1, February, 1947, pp. 2–7, illus.

Internal control mechanisms for rocket missiles must first guide the missile in a vertical direction during the critical period of take-off, automatically allowing for variations of engine thrust and accidental disturbances. As soon as the take-off has been effected, the rocket must be tilted on a smooth trajectory directed toward the target, so that at the end of the fuel-burning period the missile will have the desired azimuth direction, elevation angle, and magnitude to allow it to proceed as a free body to the objective. Control mechanisms must include devices to measure azimuth with respect to the earth and angles with respect to the true vertical, to prevent roll, and to control the fuel flow. The problem of take-off stability has been solved by the use of carbon vanes inside the throat of the rocket engine, paired with the movable surfaces of the tail fins. Gyroscopes indicate and maintain proper angles and actuate servomotors that in turn operate the control surfaces on the fins. External controls could transmit signals to the missile to change its direction and homing devices could guide it to the target.

Radio-Controlled Targets and Missiles. *The Aeroplane Spotter*, Vol. 8, No. 180, January 25, 1947, pp. 18, 19, illus.

Brief data on types of American radio-controlled aircraft for use as ground-to-air targets, ground-to-air missiles, and air-to-ground missiles.

Ice Prevention

Hot-Air Discharge for De-Icing. K. Wieghardt. (*ZWB/FB/-Re 1900*, May 26, 1943.) *U.S., Army Air Forces, Translation No. F-TS-919-RE*, December, 1946. 44 pp., figs. 9 references.

Tests were made to determine to what extent a wing can be protected against icing by hot air blown through a continuous slot at a plane measuring distance, at constant pressure. Along with the slot width and the velocity of the main flow, the discharge ratio was varied. With regard to deicing installations, the temperature of the hot-air film at the heat-impermeable wall was measured, and from these wall temperatures at large slot distances, an empiric formula was established. Discharge at greater velocity than that of the main flow is thermically unfavorable. Supplementary measurements were made of the pressure rise and drop, the mixing process of the hot and cold air, the pressure required for discharge, and the local pressure field in the vicinity of the slot.

Experimental Investigations in Formation of Ice and Water Nuclei at Low Temperatures: Inferences Regarding the Growth of Atmospheric Ice Crystals. Weickmann. (*Deutsche Versuchsanstalt für Luftfahrt, Forschungsbericht Nr. 1730*, November 18, 1942.) *Mount Washington Observatory, Monthly Research Bulletin*, Vol. 2, No. 7, July, 1946. 101 pp., illus. 40 references.

Laboratory investigations concerning the origin of droplets and ice crystals at temperatures around −40°C. are reported. The phenomena on a highly polished nickel-plated brass surface separately cooled in a cold chamber were microphotographically observed. The research apparatus was so built that room and surface temperature and the humidity relative to the condensation surface could be measured and computed for any moment, and that any possible meteorological condition could be established and maintained. In the condensation researches at temperatures above 0°C. there were three separate condensation ranges between 70 and 112 per cent relative humidity. At temperatures about −40°C. both droplets and ice crystals formed. The formation of droplets was similar to that above 0°C., except that the first condensation could not be established with certainty. Ice crystals first appeared with approach to saturation, and only on "ice nuclei" which must be brought to the surface from outside.

The Effect of Liquid and Ice Particles on the Erosion of a Supercharger-Inlet Cover and Diffuser Vanes. Vern G. Rollin. *U.S., N.A.C.A., Memorandum Report No. E6E31* (*Wartime Report No. E-178*), June, 1946. 12 pp., illus. 4 references.

Investigation of Ice Formation in the Induction System of an Aircraft Engine. I—Ground Tests. II—Flight Tests. Henry A. Essex, Carl Ellisman, and Edward D. Zlotowski. *U.S., N.A.C.A., Memorandum Reports Nos. E6B28, E6E16* (*Wartime Reports Nos. E-176, E-177*), March, June, 1946. 22 pp., illus. 2 references; 23 pp., figs. 4 references.

Instruments, Flight

The Askania Three-Gyro Automatic Pilot Control. Mauch. (*Askania-Werke a.g., Berlin, Mx/ASK*, February 14, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1064-RE*, January, 1947. 6 pp., illus.

Combining three gyro devices, it is designed to provide an electrical means for automatically measuring three magnitudes (turn, bank, and pitch). The functioning of the instrument is based on the fundamentals found in Hierholzer's calculations, which have been further developed and expressed in simple formulas.

Calibrations of Pitot-Static Tubes at High Speeds. Reece V. Hensley. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. L-396*), July, 1942. 34 pp., illus. 2 references.

Lightplane Landings—by Bombsight. Ken Davis. *Flying*, Vol. 40, No. 3, March, 1947, pp. 41, 42, 99, illus.

An instrument invented by Earl E. Flint of Wright Field will tell the exact time to cut the engine of a light plane for precise spot landing, and also which of the available areas can possibly be reached for a forced landing. This landing sight uses correlated settings of the glide speed, weight, and wind velocity in bending a ray of light through a projection screen as the site for the spot where the normal glide will land the plane.

Instruments, Meteorological

Continuous Recording of Areal Wind Speeds. Ronald L. Ives. *American Meteorological Society, Bulletin*, Vol. 28, No. 1, January, 1947, pp. 41–44, figs.

Methods of determining and of recording continuously the average wind speed over a large area, by means of a multiplicity of contacting anemometers electrically coupled to a modified Grinnell condenser-discharge recorder, are outlined, with an empiric discussion of the attainable accuracy.

The British Radio-Sonde: Report of a Discussion. *Royal Meteorological Society, Quarterly Journal*, Vol. 72, No. 312–313, April–July, 1946, pp. 169–173, illus. The construction and operation of the British Meteorological Office radiosonde, developed from a design of H. A. Thomas.

Insurance, Safety, and Rescue

Airline Safety. Emory S. Land. *Air-Sea Safety*, Vol. 2, No. 2, February, 1947, pp. 5–14, illus.

The Air-Sea Safety Problem. Alexander W. Wuerker. *Air-Sea Safety*, Vol. 2, No. 2, February, 1947, pp. 36–38. A discussion of the problems connected with air-sea preventive safety and rescue safety, with recommendations.

Check Your Risks. Duncan A. Woodman and Henry W. Roberts. *Aviation Maintenance & Operations*, Vol. 7, No. 2, January, 1947, pp. 35, 66, 68, 69.

Suggestions to fixed-base operators for determining risks, and for insuring ground structures and mobile equipment.

For Whom the Bell Tolls. II, III. Jerome Lederer. *New Zealand, Air Department, Information Circular*, Vol. 3, No. 33-34, November-December, 1946, pp. 2–4. (Cf. AER 2/47:53.)

Fatigue, emotional stress, and general mental attitude on the part of the pilot are analyzed as causes contributing to the reasons for air-line flight accidents.

Safety from the Ground Up. Frederick L. Anderson, Jr. *Air-Sea Safety*, Vol. 2, No. 2, February, 1947, pp. 40–44, illus. An outline of the ground-safety program of the A.A.F.

Factory Accident-Control. John M. Howell and Lee Johnson. *Aircraft Production*, Vol. 9, No. 100, February, 1947, pp. 68–70, figs. 2 references. An American system of analysis by graphs based on a mean rate is described.

Emergency Equipment. *Flight*, Vol. 51, No. 1990, February 13, 1947, pp. 166a, 166b, 167, illus.

Double-tube dinghies carried on British commercial aircraft have been developed as a result of war experience. They are equipped with rations, water for 5 days, and radio rescue aids.

Landing Gear

Liquid Springs for Aircraft. Arthur E. Bingham. *Dowty Equipment Ltd.* (For abstract see "I.A.S. Briefs" on page 31 of this issue, April, 1947.)

Comparison of Two Types of Nose-Wheel Control. E. Maier. (*Stuttgart, Technische Hochschule, Forschungsinstitut für Kraftfahrwesen und Fahrzeugmotoren, ZWB/FB/Re/1699*, November 17, 1942.) *U.S., Army Air Forces, Translation No. F-TS-956-RE*, February, 1947. 47 pp., figs. 9 references. Dynamics, forces, and characteristics of swivel steering and inclination steering.

The Electrical Conductivity of Airplane Tail-Wheel Tires and Its Variation in Practical Use. Wilhelm Becker. (*Deutsche Luftfahrtforschung, ZWB/FB/Re/1643*, July 28, 1942.) *U.S., Army Air Forces, Translation No. F-TS-961-RE*, February, 1947. 16 pp., illus. 3 references.

Lighter-Than-Air

Airships and the Atlantic. Lord Ventry. *Aeronautics*, Vol. 16, No. 1, February, 1947, p. 57.

The case in favor of the airship as a transportation vehicle is briefly presented. It is concluded that when the airplanes of the future are flying across the Atlantic at 600 m.p.h. and at 50,000 ft., there will still be room for the slower but much more comfortable airship cruising at 3,000 ft.

Lubrication and Lubricants

Reactions with Steel of Compounds Containing Chemical Groups Used in Lubricant Additives. Allen S. Powell. *U.S., N.A.C.A., Technical Note No. 1207*, February, 1947. 15 pp., illus. 19 references.

The chemical reactions between steel of a type used in aircraft-engine cylinder barrels and compounds containing reactive groups commonly found in lubricant additives were investigated. The products formed by reaction at temperatures from 400° to 650°F. were analyzed by reflection electron diffraction. The principal corrosive action found was caused by oxygen carried in the reactant as dissolved air or dissolved moisture. Additive reactivities were in agreement with predictions based on knowledge of the chemical reactivity of the groups and linkages tested. The reaction product could be identified when complication of the diffraction patterns by oxides of iron was eliminated. Compound formation observed in this investigation shows that additives form compounds of low shear strength at metal surfaces and prevent seizure and high abrasive wear when no fluid film is present.

Additive Type Lubricating Oils for Aircraft Engines. W. E. Kuhn and J. E. Fields. *Mechanical Engineering*, Vol. 69, No. 2, February, 1947, pp. 150–152, illus. (Extended abstract of a paper.)

The major factors involved in aircraft-engine lubrication and the methods available for improving engine maintenance through improved lubrication. The requirements for additive lubricants are stated. The results of engine and flight tests of additive lubricants are described.

Comparison of the German and Wright Field Methods for Determination of Polyisobutylene in Lubricating Oil (Project No. DP-151). Walter W. Windisch. *U.S., Army Air Forces, Technical Report No. F-TR-1135-ND*, February, 1947. 3 pp.

Development of a New Oxidation Procedure for Lubricating Oils. Richter. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/-FB/654*, July 21, 1936.) *U.S., Army Air Forces, Translation No. F-TS-923-RE*, November, 1946. 20 pp., illus.

A new oxidation process was developed which takes into consideration the volatility of the oil. In order to come to a correct conclusion about the reaction of the lubricants in the engine it is necessary to consider the loss due to evaporation of the oil and the concentration of asphalt in the residuary product. The oxidation tests carried out previously determined this asphalt formation without determining any other factors. The residuary products and excessive volatility cause engine stoppages, and for this reason those two factors have to be carefully determined.

Development of a Testing Procedure in the Single-Cylinder Engine for Gumming Tendency of Aircraft Engine Oils in Piston Rings. H. Wenzel. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/UM/494*, December, 1937.) *U.S., Army Air Forces, Translation No. F-TS-1043-RE*, December, 1946. 5 pp., tables.

One cylinder of a BMW-132 engine served as test engine. Temperature was measured at ten different spots by thermoelements. Conventional oils were used, showing similar gumming tendencies in both BMW and Siemens engines.

Materials—General

Investigation of the Transparency of Bullet-Proof Glass. Gary. (*Luftfahrtforschungsanstalt Hermann Göring, Untersuchungen und Mitteilungen 2020*, August, 1943.) *U.S., Army Air Forces, Translation No. F-TS-699-RE*, November, 1946. 18 pp., figs.

Igelit (Synthetic Rubber) Plasticizers Containing Sulfur Atoms. Karl Löffler. (*Buna-Werke G.m.b.H., Werke Schkopau, Kunststoff-Prüfstelle, Bericht*, September 20, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1049-RE*, November, 1946. 34 pp., figs.

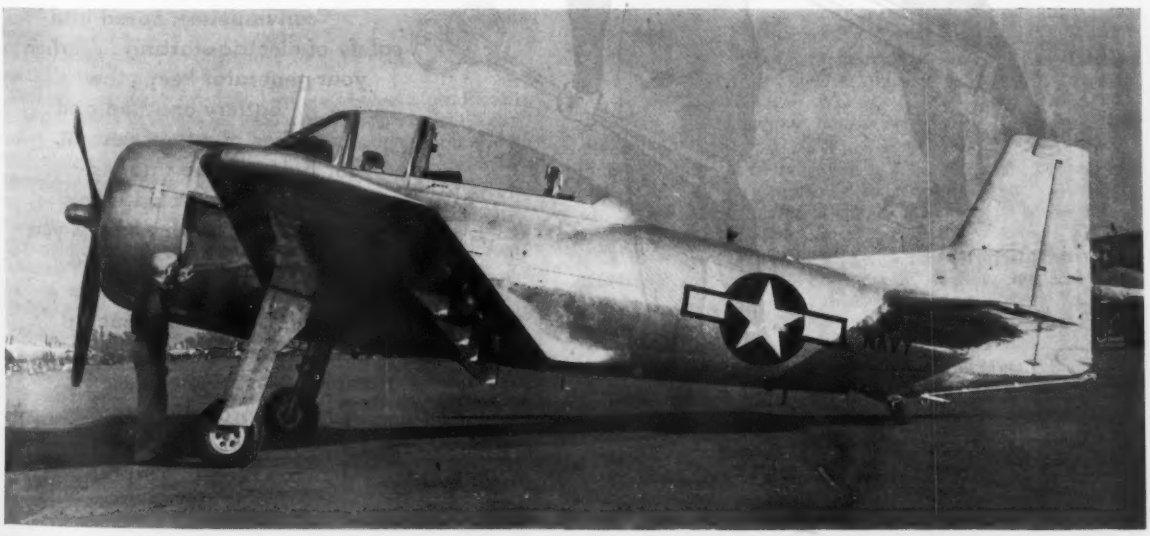
Materials—Metals and Alloys

Room Temperature Tensile Properties of Aluminum-Alloy Sheet Following Brief Elevated Temperature Exposure. J. T. Lapsley, A. E. Flanigan, W. F. Harper, and J. E. Dorn. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 148–154, figs. 5 references.

The room-temperature tensile properties of nine high-strength aluminum-alloy sheet materials have been determined after elevated-temperature exposures covering a range of times and temperatures suitable for elevated-temperature forming. Times ranged from 5 to 20 min. at temperatures up to 500°F. It is found that the naturally aged materials 24S-T, 24S-RT, and 61S-W may be exposed (without deformation) for 20 min. at temperatures up to at least 500°F. with little or no loss in yield stress. Large increases may be expected at temperatures from 450° to 500°F. The artificially aged materials 24S-T81, 24S-T84, 24S-T86, 61S-T, R301-T, and XB75S-T may be exposed as long as 20 min. (without deformation) at temperatures up to 400°F. with little or no loss in yield stress but above 450°F. the loss becomes great. Additional tests made on material taken from deep-drawn cups formed at 300° and 450°F. indicate that the deformations involved in hot forming may induce an acceleration of the elevated temperature aging process.

Fracture of Some Aluminum Alloys Under Combined Stress. E. G. Thomsen, D. M. Cunningham, and J. E. Dorn. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 2, February, 1947, pp. 81–87, illus. 6 references.

In order to study the fracture of metals under combined stresses, thin-walled tubular specimens of aluminum alloys 24S-T, 24S-T80, and 24S-T81 were subjected to axial loads and internal



The North American Aviation experimental intermediate trainer, XSN2J-1, developed for the U.S. Navy.

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pressures. The ratios of load to pressure were adjusted to give stress ratios covering the tension-tension and tension-compression fields of biaxial stress. Predictions based upon the "critical normal stress law" and the "critical hydrostatic tension stress law" were in serious disagreement with the experimental facts, while predictions based upon the "critical shear stress law" were in approximate agreement.

On the Mechanical Behaviour of Metals in the Strain-Hardening Range. G. H. Handelman and W. Prager. *Quarterly of Applied Mathematics*, Vol. 4, No. 4, January, 1947, pp. 397–407, figs.

A development of stress-strain relations believed suitable for describing the mechanical behavior of quasi-isotropic metals in the strain-hardening range. The equations cover the case of one loading followed by not more than one unloading.

Dislocation Theory as Applied by N.A.C.A. to the Creep of Metals. A. S. Nowick and E. S. Machlin. *Journal of Applied Physics*, Vol. 18, No. 1, January, 1947, pp. 79–87, figs. 12 references.

An equation for the steady-state rate of creep of pure annealed polycrystalline metals is derived through dislocation theory and the theory of rate processes. The rate of generation of dislocation is shown to be the rate-determining process. A specific mechanism for the generation of a dislocation is presented, from which the heat and entropy of activation of the process are expressed in terms of physical constants of the material. In addition, the lowering under stress of the potential energy barrier, which yields the stress-dependent term, is given in terms of constants of the material and a "back-stress" term. The creep equation thus obtained is found to be in good agreement with data in the literature.

Column and Plate Compressive Strengths of Aircraft Structural Materials: Extruded O-1HTA Magnesium Alloy. George J. Heimerl and Donald E. Niles. *U.S., N.A.C.A., Technical Note No. 1156*, January, 1947. 22 pp., illus., figs. 7 references.

Column and plate compressive strengths of extruded O-1HTA magnesium alloy were determined both within and beyond the elastic range from tests of flat-end H-section columns and from local-instability tests of H-, Z-, and channel-section columns. The results indicated by the individual curves are consistent with the comparable results for extruded 75S-T, 24S-T, and R303-T aluminum alloys for which the flange material was also stronger than the web material.

Residual Stresses in Aluminum Alloys. II. R. M. Brick. *Aluminum and Magnesium*, Vol. 3, No. 4, January, 1947, pp. 6, 7, 24, figs. 1 reference. (Cf. AER 3/47:71.)

Consideration is given to the origin and nature of residual stresses in parts fabricated from aluminum, including those made by grinding, bending, surface peening, and annealing. The subject of stress relief and the requirements for stress-relief annealing also are discussed.

Effect of Rivet or Bolt Holes on the Ultimate Strength Developed by 24S-T and Alclad 75S-T Sheet in Incomplete Diagonal Tension. L. Ross Levin and David H. Nelson. *U.S., N.A.C.A., Technical Note No. 1177*, January, 1947. 16 pp., figs. 4 references.

Data were obtained for webs that approached a condition of pure shear stress as well as for webs with well-developed diagonal tension. The rivet factor (pitch minimum diameter) divided by pitch, was varied from approximately 0.81 to 0.62. These tests indicated that the shear stresses on the gross section were nearly constant for all values of the rivet factor investigated if the other properties of the web were not changed.

Effect of Brake Forming in Various Tempers on the Strength of Alclad 75S-T Aluminum-Alloy Sheet. Walter Woods and George J. Heimerl. *U.S., N.A.C.A., Technical Note No. 1162*, January, 1947. 9 pp., illus. 3 references.

Results of tests to determine the effect on the strength in the direction parallel to the brake are presented. The tensile and compressive strengths of Alclad 75S-T sheet, formed in the O and W tempers, were either increased or little affected as compared with those of similarly treated unformed material. When Alclad 75S-T sheet "as received" was formed, however, the tensile yield stress was reduced about 7 per cent for the with-grain direction and 1 per cent for the cross-grain direction, whereas the tensile ultimate and compressive yield stresses were increased somewhat. The elongation was always reduced as a result of forming.

Compressive Strength of 24S-T Aluminum-Alloy Flat Panels with Longitudinal Formed Hat-Section Stiffeners. Evan H. Schuette, Saul Barab, and Howard L. McCracken. *U.S., N.A.C.A., Technical Note No. 1157*, December, 1946. 22 pp., illus., figs. 7 references.

Panels in which the thickness of the stiffener material is 0.625 times the skin thickness were tested. The results, presented in tabular and graphical form, show the effect of the relative dimensions of a panel on the buckling stress and the average stress at maximum load. Comparative envelope curves are presented for hat-stiffened and Z-stiffened panels having the same ratio of stiffener thickness to sheet thickness. These curves provide some indication of the relative structural efficiencies of the two types of panel.

Creeping Property of Soft Aluminum-Magnesium-Zinc Alloys at Temperatures from 90° to 180°C. Bollenrath and Gröber. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/UM/1146*, December, 1943.) *U.S., Army Air Forces, Translation No. F-TS-1058-RE*, February, 1947. 15 pp., figs.

Some aluminum-copper-magnesium and aluminum-zinc-magnesium alloys with varying zinc and magnesium contents have been subjected to 300 hours' test to determine their creeping property at temperatures from 90 to 180°C. Other physical properties of these alloys were checked and it was found that the copper content improved the creeping property. Alloys rich in magnesium show low creeping properties.

Fatigue Characteristics of Spot-Welded 24S-T Aluminum Alloy. H. W. Russell, L. R. Jackson, H. J. Grover, and W. W. Beaver. *U.S., N.A.C.A., Advance Restricted Report No. 3F16* (*Wartime Report No. W-64*), June, 1943. 88 pp., illus. 9 references.

Advancements in the Art of Heat Treating Aluminum. James F. Carland and P. R. Watson. *Aluminum and Magnesium*, Vol. 3, No. 4, January, 1947, pp. 9–11, 19, 22, illus. Includes a description of a furnace installed at Curtiss-Wright Corporation, St. Louis.

Magnesium Alloys for Aircraft. III. F. A. Rappleyea. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 70–72, 135–137, illus. 4 references. (Cf. AER 11/46:46.)

A hybrid structure using magnesium and aluminum alloys in the places in which each excels might prove to be the ideal arrangement, such as 75S-T in spar caps, Dowmetal O-1HTA extrusions as stiffeners, Dowmetal FS-1h as skin, and R301T for formed parts. An experimental magnesium-alloy wing of the type to be used on the North American SNJ-2 contained Dowmetal J-1h sheet for the skin, ribs, and shear webs, and O-1HTA bulb angles, zees, and tees were used for stringers and spar caps. It gave a weight-saving of about 14 per cent. Comparisons are made of the properties of various magnesium and aluminum alloys for members subjected to bending and for problems in lateral instability. In one example a weight-saving of 24 per cent is indicated for magnesium, and in another greater strength is obtained with equal weight. It is frequently possible to replace other alloys by magnesium alloys in torsion and gain an appreciable saving in weight, as exemplified by solid shafts and tubes. Tables and curves give comparative figures.

The Rupture Test Characteristics of Six Precision-Cast and Three Wrought Alloys at 1700° and 1800° F. J. W. Freeman, E. E. Reynolds, and A. E. White. *U.S., Advance Restricted Report No. 5J16* (*Wartime Report No. W-75*), November, 1945. 62 pp., illus.

A Metallurgical Investigation of a Large Forged Disc of 19-9 DL Alloy. J. W. Freeman, E. E. Reynolds, and A. E. White. *U.S., Advance Confidential Report No. 5C10* (*Wartime Report No. W-74*), March, 1945. 40 pp., illus. 2 references.

A Metallurgical Investigation of a Large Forged Disc of CSA (234-A-5) Alloy. J. W. Freeman, E. E. Reynolds, and A. E. White. *U.S., N.A.C.A., Advance Restricted Report No. 5H17* (*Wartime Report No. W-73*), October, 1945. 31 pp., figs. 2 references.

Colorimetric Iron Determination in Light Metals Using Sulfosalicylic Acid. R. Bauer. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/823*, May, 1937.) *U.S., Army Air Forces, Translation No. F-TS-1017-RE*, December, 1946. 11 pp., figs.

Determination of Titanium Nitride in Ferroalloys (for High Temperatures). Louis Silverman. *The Iron Age*, Vol. 159, No. 6, February 6, 1947, pp. 68, 153, tables. 6 references.

Evaluation of German Steels in Terms of United States Standards. S. R. Puffer and W. L. Badger. *U.S., Army Air Forces*

Translation No. F-TS-626-RE, November, 1946. 75 pp., tables.

German specifications covering materials used in aircraft gas-turbine work were supplied by German officials and have been translated and compared with materials in current use in American gas-turbine practice. These comparisons were made with the specification numbers of the American Society for Testing Materials, the Society of Automotive Engineers, and General Electric Company, or with trade names.

Metallurgical Applications of the X-Ray Diffraction Spectrometer. I, II, III. John L. Abbott. *The Iron Age*, Vol. 159, Nos. 7, 8, 9, February 13, 20, 27, 1947; pp. 50–53, illus.; pp. 57–61, figs.; pp. 56–59, figs. 6 references.

I. The Geiger counter X-ray diffraction spectrometer coupled with the Brown ElectroniK strip-chart recorder, provides a means of X-ray diffraction analysis on a production basis. The wide range of industrial application of this equipment for producing X-ray diffraction patterns is described, and also various aspects relating to the operation of the equipment. Diffraction curves indicate the influences of apparatus variables on diffraction patterns. **II.** A study is made of the effects of heat-treatment on the X-ray diffraction patterns of SAE 33.12 steel and 24S aluminum, and the effects of cold working on the X-ray diffraction pattern of SAE X4340 steel. The metallurgical structure of each specimen is correlated with the corresponding diffraction curve. **III.** The versatility of the Geiger counter X-ray spectrometer is further emphasized by presenting chemical analyses of an aluminum brazing flux and two stainless-steel welding rod coatings, in the form of diffraction patterns. The use of the X-ray diffraction spectrometer is compared with chemical and spectrographic methods of analysis.

The Metallurgical Microscope—Its Range and Use. D. E. Roda. *The Iron Age*, Vol. 159, No. 9, February 27, 1947, pp. 53–55, illus.

Rigidized Metal—A Modern Material. D. E. Olshevsky. *Materials & Methods*, Vol. 25, No. 2, February, 1947, pp. 93–98, illus.

The physical properties, advantages, and applications of "rigidized metal" in the form of sheet or strip. Its structural strength and dead-weight saving features make it suitable for certain aircraft uses.

Materials—Plastics and Plywood

The Water Absorption of Thin Igelit-Foils; A Contribution to the Manufacture of a Polyvinylchloride Suitable for the Coating of Black Iron Plate. Karl Löffler. (*IGF/L/Mit/P/55/42*, November, 1942.) *U.S., Army Air Forces, Translation No. F-TS-1014-RE*, December, 1946. 7 pp.

The Setting Process of Wood Gluing. I. Eugen Bock. (*I. G. Farbenindustrie a.g., IGF/M K/1*, December, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1061-RE*, January, 1947. 23 pp., illus. 5 references.

Styrene Residues as Plasticizers for Igelit PCU. Karl Löffler. (*Schkopau, IGF/L/Mit/P/42/42*, May, 1942.) *U.S., Army Air Forces, Translation No. F-TS-1039-RE*, December, 1946. 4 pp.

Plasticized Igelit PCU was rolled at a temperature of 160°C. and gelatinized over a period of 20 min. During these operations the residues evaporated. Results led to rejection of styrene residues as plasticizers.

Apparatus for Determining Metallic Potassium Content in Potassium-Raw Plasticizer 32 Produced by a Continuous Process. Orth. (*Schkopau, IGF/L/Mit/P/78/43*, August, 1943.) *U.S., Army Air Forces, Translation No. F-TS-1019-RE*, January, 1947. 6 pp., illus.

Experimental Comparison of Forerun Fatty Acid Esters of Octanetetrol, Hexanetriol and Pentaerythrite as Plasticizers for Igelit PCU. Karl Loeffler. (*IGF/L/Mit/P/19-41*, December, 1941.) *U.S., Army Air Forces, Translation No. F-TS-1013-RE*, February, 1947. 7 pp.

Distribution of Strength Values in Wood for Aircraft Construction. J. T. Drow, M. E. Clark, and T. R. C. Wilson. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1515*, February, 1946. 45 pp., figs.

A review of the values set forth in tables 2 and 3 of ANC-18 gives consideration to (1) recent experience of designers and builders of wood aircraft, (2) recent findings both on the moisture content of wood in service and on the effects of rate of loading and duration of load, and (3) deviations of strength values from those to which the criteria correspond. Data on the distribution and variability of strength properties are presented.

Buckling of Stiffened, Flat, Plywood Plates in Compression; A Single Stiffener Perpendicular to Stress. T. B. Heebink, H. W. March, and C. B. Norris. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1553*, June, 1946. 33 pp., figs.

A mathematical analysis is presented of the critical stress of a plywood plate in edge compression stiffened by means of a stiffener glued to the plate. The analysis yields an approximate formula for the minimum stiffness of the stiffener required to cause the plate to buckle into two half-waves rather than into one. The data from 371 tests of 60 plates suggest a modification of the formula by an empiric factor, probably made necessary by the original lack of flatness of the plates.

Weight and Dimensional Stability of Three Low-Density Core Materials. E. A. Mraz and W. F. Hutchins. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1544*, May, 1946. 4 pp., table.

Specimens of balsa wood, Hycar, and cellular cellulose acetate core materials used in sandwich construction were tested by immersion in the following chemical test liquids: iso-propyl alcohol; ethylene glycol; 3580 oleo fluid, hydraulic (light petroleum base) Specification No. 3580-c; 3586 oleo fluid, hydraulic (castor oil base) Specification No. 3586-c Grade A—heavy; 100-octane gasoline; used crankcase oil; and distilled water. The specimens were soaked for 7 days, followed by conditioning for periods of 7 and 39 days, and the average gains in weight, thickness, width, and length were tabulated.

Impact Resistance of Three Core Materials and Six Sandwich Constructions as Measured by Falling-Ball Tests. K. H. Boller. *U.S., Forest Products Laboratory, Madison, Wis., Report No 1543*, February, 1946. 16 pp., figs.

Each of three materials (1) balsa, (2) hard, synthetic sponge rubber (a proprietary product), and (3) cellular cellulose acetate were tested separately and in combination with two facing materials consisting of aluminum and resin-impregnated glass cloth. The ball was dropped from progressively increasing heights and the condition of the materials and the deflection were observed after each drop. Deflection was found to be proportional to height of drop until a "critical deflection" was reached, after which deflection increased much more rapidly. Hard sponge rubber and cellular cellulose acetate core materials were about equal in resistance to damage. The balsa wood was inferior to both of these. Aluminum and glass-cloth facings were about equal.

Compression, Tension, and Shear Tests on Yellow-Poplar Plywood Panels of Sizes That Do Not Buckle with Tests Made at Various Angles to the Face Grain. IV—Summary and Conclusions. C. B. Norris and P. F. McKinnon. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1328*, January, 1946. 42 pp., figs.

This report is a summary of three separate studies reported in the supplements A, B, and C. It deals with the elastic properties and the strengths, at proportional limit and ultimate, of plywood subjected to stresses acting in the plane of the plywood and at various angles to the grain. Investigation of the theoretic relationships is based on tests made on yellow-poplar plywood specimens so proportioned that they would not buckle or fail because of elastic instability. Incorporated in this report are the theoretic development of equations for calculating the elastic moduli and the strength values of plywood subjected to tensile, compressive, or shear stresses acting in the plane of the plywood and at various angles to the face grain. Graphs showing the comparison between the experimental data and theoretic curves are included. As a whole the agreement between theory and experiment is good. It is assumed that the equations are applicable to plywood of other species as well.

Moisture Content of Wood in Airplane Structures. J. T. Drow and M. E. Clark. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1552*, December, 1945. 19 pp., figs.

Tests of actual aircraft parts indicate that the present value of 15 per cent moisture content used in wood aircraft design is not high enough to include all conditions of service. Studies of matched specimens at various locations showed, on uncoated and on varnished material, maximum values considerably in excess of 15 per cent in the United States. On the other hand, the conditions of exposure for these specimens were different from those

encountered in aircraft structures. The determination of a proper design moisture content would appear to depend largely upon a decision as to whether such a design value is to be fixed at a level high enough to include: (1) all, (2) a substantial percentage, or (3) some lesser percentage of moisture-content values that might be encountered under severe conditions.

Lightweight Laminated Construction Sheets of Plastic and Fibrous Materials in Combination with Metallic Materials, Plywood, and Plastic Laminations. W. Kuech. (*Lilienthal-Gesellschaft für Luftfahrtforschung, Bericht 157.*) *U.S., Army Air Forces, Translation No. F-TS-754-RE*, November, 1946. 33 pp., figs.

Structural parts made of these materials are able to absorb compressive loads, even after elimination of a large number of braces, without important deformation or buckling before the breaking load is reached. Pressure experiments on dural airfoil sectors of thickness of 0.0137 in. and a kinking rate of 14.96 in. gave breaking strength of about 80 per cent of the value of the compressive strength of dural, or 200 per cent of the maximum values for standard airfoils. A further increase in strength is to be expected. Bonded sheet constructions offer special advantages also in wood constructions. At the same strength, and especially for high loads, the weight required is lower for plywood bonded sheets than for steel or dural bonded sheets. The most suitable reinforcing materials for metals are primarily expanded hard rubber, and for wood, Polystal foam and expanded wood-fiber plastics.

Development of Joint Strength in Birch Plywood Glued With Phenol-, Resorcinol-, and Melamine-Glues Cured at Several Temperatures. H. D. Bruce, W. Z. Olson, J. M. Black, and A. H. Rauch. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1531, Revised*, April, 1946. 27 pp., figs.

To obtain information about the curing characteristics of certain commercial intermediate- and room-temperature glues, plywood was made with them by pressing at several temperatures for various lengths of time, and the strength of the joints so made was ascertained by shear tests. The joints increased in strength with increased temperature and time of heating until the glue became sufficiently cured to develop the full strength of the wood. Differences between glues in rate of development of joint strength were taken as indicative of diverse curing characteristics.

Strength of Joints in Hard Maple Blocks, Glued With Certain Resin Glues, After Various Open and Closed Assembly Periods. W. Z. Olson and H. D. Bruce. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1542*, May, 1946. 19 pp., figs.

Blocks of hard maple lumber were glued together with each of nine commercial resin glues, allowing various periods of open and closed assembly within the range customarily required in practical gluing operations. This was done at three room temperatures. After the joints were cured and conditioned, they were tested for strength and the test data were plotted to reveal the effect of the assembly period and temperature on the joint strength. The nine glues tested were of the following types: three were intermediate-temperature-setting phenol resins; four were room-temperature-setting resorcinol resins; one was an intermediate-temperature-setting melamine resin catalyzed with acid to accelerate the setting; and one was a nearly neutral intermediate-temperature-setting melamine resin.

Veneer and Plywood Manufacturing Techniques and Machinery Observed in Western Germany. R. M. Seborg and H. O. Fleischer. *U.S., Field Information Agency, Technical, Final Report No. 389*, October 15, 1945. 41 pp. 9 references. U.S., Forest Products Laboratory, Madison, Wis.

Useful techniques and machinery not cited previously which may be of interest and value to American industry are described.

Summary of Investigators Reports on Technical Industrial Forest Products Developments in Germany. *U.S., Joint Intelligence Objectives Agency, Forest Products Subcommittee*, February, 1946. 66 pp. U.S., Forest Products Laboratory, Madison, Wis.

German research and technological and industrial development of forest products were found to be generally behind those of the United States. The most significant developments that would be of interest to American wood industries and research include methods for the production of alcohol, resin adhesives, pulps, and impregnated-wood retainers for high-speed ball and other bearings.

Production and Fabrication of Glued Wood Products in Western Germany. R. M. Seborg and H. O. Fleischer. *U.S., Field Information Agency, Technical, Final Report No. 366*, October 16, 1945. 68 pp. 21 references. U.S., Forest Products Laboratory, Madison, Wis.

Bag-molding was not used, small aircraft parts being molded in presses and larger units being glued between wood molds; electrical-resistance heating was used in the gluing of molded parts; high-frequency heating was employed for gluing spars; low-density core panels were in the experimental stage. Unsuccessful experiments had been made with foam materials, cellular-construction cores, and wood-fiber panels covered with metal skins. Connections of large wooden structural parts were by bolts, and for connections of small bolts to plywood a special nut forming a rivet-like union with the plywood was used. Wooden propellers were generally made of veneers compressed to specific gravities as high as 1.4.

Comparison of Commercial Water-Soluble Phenol-Formaldehyde Resinoids for Wood Impregnation. Horace K. Burr and Alfred J. Stamm. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1384, Revised*, December, 1945. 21 pp., figs. 7 references.

Ten different commercial resinoids are evaluated for use in the manufacture of impreg and compreg. They are compared relative to their solubility, solids content (by a new reproducible method), viscosity, hydrogen-ion concentration, and curing conditions. Practically equal antishrink efficiencies were obtained on impreg made with these ten resinoids. Compreg made with these same treating resinoids, both with and without an additional bonding resin, had high shear strengths and good Izod values as judged from the notched toughness strengths.

Acetylated Wood. Harold Tarkow, Alfred J. Stamm, and E. C. O. Erickson. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1593*, May, 1946. 29 pp., figs. 18 references.

Wood is treated with chemical vapors to improve its dimensional stability when exposed to severe and prolonged high humidity or immersed in water over extended periods of time. Treating the wood with vapors of a solution of acetic anhydride replaces the relatively hygroscopic hydroxyl groups in the wood with less hygroscopic acetyl groups. The wood is left in a permanently swollen condition by means of the bulking action of the acetyl groups within the cell walls. Acetylation to about a 20 per cent acetyl content reduces shrinkage about 70 per cent as compared with untreated wood. Limited tests indicate that the treatment is permanent. A few tests indicate that strength properties are not impaired and in some cases may be improved.

Medicine

The Psychological Background of "Pilot Error" in Aircraft Accidents. E. Charles Kunkle. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 533–567, figs. 98 references.

A search for some of the human factors that may lead to an aircraft accident was made with the particular object of determining the characteristics that differentiate the safe from the unsafe pilot. The observations involve certain propositions related to the past performance and significant personality traits of successful and unsuccessful pilots, and the personal factors that may directly predispose to an aircraft accident. Studies are made of the general nature of "pilot error," the concept of accident proneness, and the evolution of pilot-selection techniques. A method of investigation involving confidential interviews with 200 rated A.A.F. pilots is described. The results of the investigation indicate that an individual's performance at home, at school, and at work is a useful criterion of his ability to fly safely.

The Protection of the Human Body from Impact Forces of Fatal Magnitude. Howard R. Bierman. *The Military Surgeon*, Vol. 100, No. 2, February, 1947, pp. 125–141, illus. 12 references. (Cf. AER 2/47:53.)

It is possible to protect aircraft personnel in accidents from accelerative forces up to 65*g*. Many injuries may be caused by inadequate restraining devices. Six fundamental principles that will diminish the effect of linear acceleration forces are listed. These principles have been incorporated in the construction of a vest-type harness of undrawn nylon and have protected humans from high impact forces. Parachute riser straps of the same material have provided protection against impact forces.

No Radio "Noise Nuisance" in the Martin 2-0-2 . . . thanks to American Shielding Conduit

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Global Aviation Medicine in the Air Transport Command. M. S. White. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 579–583.

A description of the aviation medical problems encountered in global air transportation shows their relationship to the air crews, the passengers, and the evacuation of casualties.

Research in Aero-Medicine. Malcolm C. Grow. *The Military Surgeon*, Vol. 100, No. 2, February, 1947, pp. 123–125.

A review of some of the projects that aero medical research must accomplish in the forseeable future, including problems posed by transonic and supersonic aircraft.

Studies on Altitude Decompression Sickness. III—The Effects of Denitrogenation. John S. Gray, S. C. F. Mahady, and R. L. Masland. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 606–610, tables. 1 reference.

The Use of Drugs for the Prevention of Decompression Sickness. O. L. Williams, W. R. Lyons, E. V. Bridge, and S. F. Cook. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 602–605, 657, tables. 7 references.

Pathological Lesions Produced by Explosive Decompression. Abraham Edelmann, W. V. Whitehorn, Allen Lein, and Fred A. Hitchcock. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 596–601, 612, tables. 5 references.

Internal Injuries Produced by Abrupt Deceleration of Experimental Animals. Robert F. Rushmer, Earl L. Green, and Harry D. Kingsley. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 511–525, 589, illus. 16 references.

Effects of Increased Intrapulmonary Pressure on Dark Adaptation. Charles Sheard. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 526–532, figs.

The Effect of Pressure Breathing on the Cutaneous Temperatures of the Extremities. J. B. Bateman and Charles Sheard. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 568–578, 583, figs. 5 references.

Variations in the Angioscotoma in Response to Prolonged Mild Anoxia. G. M. Smith, C. P. Seitz, and K. B. Clark. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 590–595, figs. 10 references.

Nursing in Air Evacuation. Emily G. Purvis. *The Military Surgeon*, Vol. 100, No. 2, February, 1947, pp. 165–168.

Human Problems in Military Aviation. Detlev W. Bronk. *Smithsonian Institution, Publication No. 3836*, 1946. Govt. Printing Office, Washington, 1946. 11 pp. (From the *Report for 1945*.)

Meteorology

The Future Role of Rapid Computing in Meteorology. John von Neumann. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 30 of this issue, April, 1947.)

Tentative Tables for the Properties of the Upper Atmosphere. Calvin N. Warfield. *U.S., N.A.C.A., Technical Note No. 1200*, January, 1947. 56 pp., figs., tables. 20 references.

The N.A.C.A. has adopted three temperature-height relationships and one composition-height relationship, and two sets of tables based upon them have been prepared for the atmosphere from 65,000 to 393,700 ft. The first set of two tables is based upon the same arbitrary constant value for the acceleration of gravity that was used in the preparation of the existing standard tables for the lower levels (*NACA Report No. 218*, 1925) and constitutes a consistent extension of the existing standard tables. The second set of two tables takes into consideration the decrease in the acceleration of gravity with increasing altitude. Among the quantities listed in these tables according to altitude are temperature, pressure, density, specific weight, coefficient of viscosity, speed of sound, and the mean free path of the air molecules.

Humidity of the Air; Definitions, Formulae, and Constants. *British Standard 1339*, 1946. 8 pp. British Standards Instn., London. 2*s*.

Results of the Air Weather Service Frontal-Analysis Numerical-Scoring Program. Leo Alpert. *American Meteorological Society, Bulletin*, Vol. 28, No. 1, January, 1947, pp. 29–36, figs.

A frontal-analysis numerical-scoring system employed by the Air Weather Service to obtain a more uniform frontal analysis by different forecasters working with identical data is outlined. Although the system is not a substitute for meteorological knowledge and professional experience, it serves as a means to assure the habit of adequate consideration of all factors involved in frontal analysis.

Inclined Streamline Flow. W. Schaffer. *Royal Meteorological Society, Quarterly Journal*, Vol. 72, No. 312-313, April–July, 1946, pp. 235–250, figs. 4 references.

Equations of motion for air currents flowing at an angle to the horizontal are derived. From these an equation is developed relating the veering or backing of the wind with height to the rate of ascent of the air and the local rate of rise of temperature. An implication concerning the upper pressure field is briefly investigated and finally some simple illustrative examples are given.

Energy in the Atmosphere. Sir Charles Normand. *Royal Meteorological Society, Quarterly Journal*, Vol. 72, No. 312-313, April–July, 1946, pp. 145–168, illus. 4 references.

An examination of the heat drop in cumulo-nimbus clouds leads to a realization that the available energy is largely dependent on the mode of descent of the down currents required to compensate the up currents. In the generation of tropical cyclones two neighboring air masses may give rise to a sudden increase in latent instability, which seems of more importance than any other thermal property of the frontal zone between them.

Comments on the Sea-Breeze Circulation. B. Haurwitz. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 1–8, figs. 4 references.

Since the sea breeze is caused by the temperature difference between the air over land and that over water, its intensity might be expected not only to increase while the temperature difference increases to its maximum but also to continue increasing until the difference decreases to zero. In a model taking friction into account the intensity of the sea breeze begins to decrease considerably earlier, in better agreement with the observations. The diurnal rotation of the sea breeze can be explained as an effect of the Coriolis force.

An Elementary Theory of the Land- and Sea-Breeze Circulation. F. H. Schmidt. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 9–15, figs. 12 references.

An attempt is made to find an elementary solution for the problem, disregarding the mutual influence of temperature distribution and velocity. A simple temperature distribution is adopted *a priori*, and the velocity distribution is calculated from it. Account is taken of the deflecting force of the earth's rotation. The result shows that in temperate latitudes the sea breeze, when at full strength, does not blow perpendicular to the coast.

The Use of Airborne Navigational and Bombing Radars for Weather-Radar Operations and Verifications. Robert W. Miller. *American Meteorological Society, Bulletin*, Vol. 28, No. 1, January, 1947, pp. 19–28, illus.

A project was undertaken by the Air Matériel Command to determine the precise meteorological conditions that prevail within a radar echo and the best method of using radar systems for weather purposes in an operational sense. A comparison of AN/APQ-13A and AN/APS-10 equipment was made with regard to beam widths, peak power outputs, and antenna gains. Comparisons of "weather" and "normal" pulse lengths and pulse repetition frequencies on both radars also were made.

Radar Detection of a Frontal Storm in June, 1946. Raymond Wexler. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 38–44, illus. 6 references.

The theory of radar storm detection is briefly stated and applied to detection of the frontal storm of June 18, 1946. The precipitation pattern associated with the front is found to be a series of overlapping line squalls each about 100 miles in length. The mean rain intensity along the front is computed with the aid of radar theory.

An Investigation of the Use of High-Altitude Winds in Forecasting Weather in the Aleutians. Robert E. Parker and John Cochrane. *American Meteorological Society, Bulletin*, Vol. 28, No. 1, January, 1947, pp. 15–18, tables.

The Forecasting Significance of High-Level Winds (20,000–60,000 Ft.) in Sub-Arctic Regions. Vincent J. Oliver. *American Meteorological Society, Bulletin*, Vol. 28, No. 1, January, 1947, pp. 9–14, figs. 4 references.

Over-Water Refraction of 10-cm. Electromagnetic Radiation. R. B. Montgomery. *American Meteorological Society, Bulletin*, Vol. 28, No. 1, January, 1947, pp. 1–8, figs. 11 references.

Radiative Cooling in the Lowest Layers of an Atmosphere Warmer Than the Ground. H. A. Panofsky. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 35–37, figs. 6 references.

Extratropical Cyclogenesis in the Pacific Coastal Region of Asia. James E. Miller and Homer T. Mantis. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 29–34, figs. 1 reference.

Microseisms and Weather Forecasting. B. Gutenberg. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 21–28, figs. 31 references.

An Empirical Study of Certain Rules for Forecasting the Movement and Intensity of Cyclones. J. M. Austin. *The Journal of Meteorology*, Vol. 4, No. 1, February, 1947, pp. 16–20, tables. 5 references.

Measurements of Temperature and Humidity in the Lowest 1000 Feet of the Atmosphere over Massachusetts Bay. Richard A. Craig. *Massachusetts Institute of Technology, Papers in Physical Oceanography and Meteorology*, Vol. 10, No. 1, November, 1946. Woods Hole Oceanographic Institution, Woods Hole, Mass. $0.75.

The Ionisation in the Lowest Regions of the Atmosphere. J. Alan Chalmers. *Royal Meteorological Society, Quarterly Journal*, Vol. 72, No. 312–313, April–July, 1946, pp. 199–205, fig. 8 references.

The result of Hogg (1939) that the positive and negative conductivities in the air vary with height in the lowest regions of the atmosphere, and the fact of a field strength almost unaltered with height can be reconciled by assuming the rate of ionization to depend upon the height.

Military Aviation

The Use of Body Armor in Aviation During Wartime. Malcolm C. Grow. *The Journal of Aviation Medicine*, Vol. 17, No. 6, December, 1946, pp. 500–503.

Examination and Test of the ZFR4A German Gunsight (Project No. NAD-25). Harry W. Rapp. *U.S., Army Air Forces, Technical Report No. F-TR-1128-ND*, January, 1947. 27 pp., illus.

Ultrahigh Frequency Sight Unit (The "Holzwurm" Airborne Radar Search Set for Fighter Aircraft). K. Schmid. *(Flugfunkforschungsinstitut Oberpfaffenhofen, Gauting, EIS/Ber. FFO/3.) U.S., Army Air Forces, Translation No. F-TS-1063-RE*, February, 1947. 4 pp.

Radio Proximity Fuze. *U.S., National Bureau of Standards, Technical News Bulletin*, Vol. 31, No. 1, January, 1947, pp. 3–8, illus. The development, production, and use of the VT (variable time) fuse and its modifications.

The Optical Proximity Fuze. F. A. Zupa. *Bell Laboratories Record*, Vol. 25, No. 2, February, 1947, pp. 70–74, illus.

Naval Aviation

The Passing of the Flat-Top? Norman Macmillan. *Aeronautics*, Vol. 16, No. 1, February, 1947, pp. 26, 27.

Current weapon development may soon impose great changes in aircraft-carrier operations which will, in turn, affect naval architecture in the carrier classes of warships. What these changes may be, and how they may affect air-sea tactics, is described.

Our Navy's Wings. Art Macdonald. *Canadian Aviation*, Vol. 20, No. 2, February, 1947, pp. 18, 19, 24, illus. A review of the growth of Canada's naval air force.

Navy Fire-Control Radars. W. M. Kellogg. *Bell Laboratories Record*, Vol. 25, No. 2, February, 1947, pp. 64–69, illus.

Magnetic Airborne Detectors. E. N. Snow and R. G. S. Sewell. *U.S., Army Air Forces, Intelligence Review No. F-IR-99-RE*, January, 1947. 43 pp., figs. 3 references.

A description and history of the development of a Japanese device for submarine detection, the operating principle of which depends upon the variation of the earth's magnetic field caused by the metal in the submarine.

Navigation

The Impact of Supersonic Speeds upon Air Navigation: 1946-1947 Development Program. *Institute of Navigation, Technical Development Committee for Air*, 1946. 7 pp.

Navigation equipment, instruments, maps, charts, procedure, and the training of personnel will have to be revised to meet the new conditions imposed by the supersonic speeds of the future. The operational fields of air navigation to be studied, integrated, and coordinated by professional navigators include celestial navigation methods, instruments, loran, radar, radio, aerology and altimetry, cruising control and flight planning, charts and publications, films and photography, training devices, and transoceanic and transcontinental analysis. Each of these subjects is examined in the light of subsonic and supersonic speeds, and the trend of development is outlined.

Minutes of the Polar Navigation Subcommittee Symposium, 16–20 December 1946. *Institute of Navigation, Technical Development Committee for Air*, 1947. 7 pp., illus. Reports of the sessions and brief abstracts of papers presented at a meeting dealing with a variety of navigational problems.

Altimetry Navigation. II. *New Zealand, Air Department, Information Circular*, Vol. 3, No. 33-34, November-December, 1946, pp. 21–24, fig. (Cf. AER 2/47:61.)

The technique of single-heading flight appears to offer all the advantages of pressure-pattern flying without the need for extensive preflight planning. By measuring at two points the absolute height of a given pressure level, it is possible to calculate the drift of an airplane flying between those points. Applying the calculated mean drift to the known rhumb-line track gives a single heading that should take the craft to its destination. The method of calculation is explained.

Ingenious New Calculator. *Flight*, Vol. 51, No. 1986, January 16, 1947, pp. 72, 73, diagrs.

The design and use of the Watts dead-reckoning navigation computer for calculating degree of track, course and ground speed, distance along any track, time required for distance, true air speed, conversion of knots and kilometers, and plotting of radio bearings. The computer consists of a slide-rule base bar at one end of which is pivoted a transparent ruler with a slot cut along the centerline and a circular head in which is set a dial and a wind bar. An elastic rubber scale in the base bar provides corrections for ground speed, altitude, and temperature, and conversion for Mercator charts and statute miles.

Parachutes

The Rate of Descent of Parachutes from Various Altitudes. Kenneth E. Penrod, George L. Maison, and James E. McDonald. *Boston University and Iowa State College.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, April, 1947.)

Photography

Tri-Metrogon Charting. Keith Newhouse. *The Nebraska Blue Print*, Vol. 46, No. 5, February, 1947, pp. 101, 114.

A system of aerial mapping utilizing three cameras and a metrogon wide-angle lens greatly reduces the time required to make charts sufficiently accurate for navigational purposes.

Private Flying

Executive Planes Lead the Way. Franklin M. Reck. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 38–41, 132, 133, illus.

"That Flying Dollar"—How It Flies! R. I. Hale. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 36, 37, illus. Observations about the factors tending to retard the growth of private flying.

Airlines vs. Private Flying. Edward Doherty. *Flying*, Vol. 20, No. 2, February, 1947, pp. 32, 33, 70, illus. A plea for action to solve the disagreements and operating problems which are stated to be arising between commercial and private fliers.

Production—General

Complete Aircraft; December 1946 and Summary for Year. *U.S., Bureau of the Census, Facts for Industry, Series No. M42A-126*, February 5, 1947. 6 pp. Tabulated statistics regarding the number, weight, value, and types of aircraft produced and shipped to Government and other purchasers in the year 1946.

Production Methods

Vickers-Armstrongs Viking. II—Wing Construction and Assembly; Installation of Compound Tank Units; Use of Geo-

detic Inner Wings. S. G. Poulsen. *Aircraft Production*, Vol. 9, No. 100, February, 1947, pp. 46–54, illus.

Notable points in the wing construction are the mounting of the tanks without the conventional cradles and straps, and the building of the inner wings without the use of a main fixture. The latter technique depends on the employment of nine jig-built subassemblies that are sufficiently rigid and accurate to give correct final dimensions when assembled.

A Light Aeroplane in Production: Some Details of the North American Navion Manufacturing and Tooling Processes Applied as the Outcome of Wartime Experience. *Aircraft Engineering*, Vol. 19, No. 215, January, 1947, pp. 29–31, illus. (Cf. AER 2/47:36.)

Photographic Reproduction as an Engineering Tool. Dyche E. Clark. *The Iron Age*, Vol. 159, No. 6, February 6, 1947, pp. 60–63, 121, illus.

How the use of photographic reproductions has reduced costs and speeded various phases of manufacturing operations at the Ryan Aeronautical Company. The techniques and equipment used in transferring drawings directly to the material to be fabricated are described.

Molybdenum Steel Riveting. *The Iron Age*, Vol. 159, No. 7, February 13, 1947, p. 49, diagr.

The setting of molybdenum steel rivets by means of an electric riveting machine involves severe service for the riveting tips. By shrouding the tungsten-carbide tip in a molybdenum steel cup, a run of 700 operations was made with few signs of cracking. The device has been used successfully in the assembly of gas-turbine blades.

Plunge Grinding; Economies Effected by Rotol Ltd., in Machining Airscrew Parts. *Aircraft Production*, Vol. 9, No. 100, February, 1947, pp. 43–45, illus.

Substantial economies in production time have been effected in the machining of propeller parts embodying profiles with blended radiuses by the substitution of plunge grinding for a combination of profile turning and blending. This process has been applied to a number of parts, including the hub for a two-bladed propeller.

Low-Temperature Cooling in the Machining Process of Metals. G. Pahlitzsch. (*TSRWF-2/1*, July, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1065-RE*, February, 1947. 21 pp., figs.

Controlled Annealing of Strain Hardened Al Alloys. P. W. Boone and David Lewis, II. *Aluminum and Magnesium*, Vol. 3, No. 4, January, 1947, pp. 8, 20, tables.

An investigation was carried out at The Glenn L. Martin Company to determine if 52S1/2H aluminum-alloy sheet could be converted to the 1/4-hard condition by heating at a temperature somewhat below that required for a full anneal. It was found that partial annealing is entirely practical, and the final properties of the material can be closely controlled by proper selection of annealing temperature and the time of treatment.

The High-Frequency Heating of Nonconducting Materials. F. J. Jolly. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 2, February, 1947, pp. 155–162, figs. 5 references.

Assembly of Aluminum Parts by Furnace and Dip Brazing Methods. A. H. Petersen. *Product Engineering*, Vol. 18, No. 2, February, 1947, pp. 115–117, illus.

The use of jigs, self-positioning assembled units, tack welding, and riveting to hold assemblies during brazing are discussed, including the cleaning and corrosion protection of brazed assemblies.

Nonhydroscopic and Noncorrosive Fluxes Employed in the Welding of Aluminum and Magnesium Alloys in Germany (Project No. GQ-201). C. A. Naugle. *U.S., Army Air Forces, Technical Report No. F-TR-1137-ND*, February, 1947. 3 pp.

The Classification and Recording of Spot-Weld Defects Revealed by Radiography. R. C. McMaster, F. C. Lindvall, and Edythe Dial. *The Welding Journal*, Vol. 26, No. 2, February, 1947, pp. 121–128, illus. 8 references.

Details are given about a method of classifying the presence and extent of spot-weld defects revealed by radiography, by which observations from spot-weld radiographs can be recorded and transmitted from one individual to another. From these tentative classifications, process-control engineers and inspectors can establish standards and specifications of acceptance levels for each individual defect or group of defects. The classification presented has been used to advantage in extensive factory tests in the spot-welding departments of three West Coast aircraft manufacturers.

Pressure Welding of Light Alloys Without Fusion. R. F. Tylecote. *The Welding Journal*, Vol. 26, No. 2, February, 1947, pp. 88–103, figs. 16 references. (Cf. AER 2/46:71.)

Pressure Welding. E. R. Proctor. *Aircraft Production*, Vol. 9, No. 100, February, 1947, pp. 63–66, illus. 2 references. The Menasco Uniweld tube-welding technique adapted to commercial production of aircraft landing-gear legs is described.

Pressure-Welding Stainless Steel Rings. Arnold L. Rustay, Alan Crowell, Stephen M. Jablonski, and Charles J. Burch. *The Welding Journal*, Vol. 26, No. 2, February, 1947, pp. 129–137, illus. 2 references.

The pressure-welding process was adapted to the production of optimum-quality welds for aircraft applications. It was found essential to control surface preparation, end pressure, and rate of heating to insure intimate contact of the weld faces during the initial period of the welding cycle. Close control of temperature and gas flow, particularly with Type 310 stainless steel, was necessary to realize welding temperature high enough to insure weld quality and the minimum of gradient to preclude surface burning. A proof test of expanding or forging proved successful in insuring sound welds in that only optimum quality welds were able to meet the requirements of these tests.

New Frontiers in Welding. Wendell F. Hess. (Adams Lecture for 1946.) *The Welding Journal*, Vol. 26, No. 2, February, 1947, pp. 114–120. 25 references.

Progress Report on the Flash Welding of High-Strength Aluminum Alloys. R. Della-Vedowa and E. A. Reynolds. *The Welding Journal*, Vol. 26, No. 2, February, 1947, pp. 81–87, illus. 3 references.

Techniques were developed for the high-quality flash welding of 24S-T aluminum-alloy tubing and bar stock. Joint efficiencies and joint strength consistencies were determined by static tension tests of welded specimens. Tests were also conducted on representative specimens to determine the corrosion susceptibility of the weld area, when unprotected and under a protective coating.

Propellers

Frequency "Admittance" Curves for Coupled Engine Crankshaft (Torsional) and Contra-Revolving Propeller (Flexural) Vibrations. J. Morris. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2012*, April, 1943. 12 pp., figs. 4 references. British Information Services, New York. $0.90.

The "admittance" method for dealing with coupled vibrations of engine crankshaft-propeller systems is adapted to cover the case of counterrotating propellers. The propellers may or may not be equal, and they may or may not revolve at equal speeds. Through examples using simple pulley arrangements, the equivalent polar moment of inertia is explained. The calculations are applied to the case of a single crankshaft with two counterrotating propellers, and to two coupled crankshafts with two counterrotating propellers. Calculations for the node at the gears, by two comparable methods, show that the greatest error is 2 per cent in the square of a frequency, and that an "equal" approximation method of finding the fundamental frequency gives results approaching closely to the more accurate method. Examples are worked out for the case of two engines not geared together and for two engines in combination.

Free-Flight-Tunnel Investigation of the Effect of Mode of Propeller Rotation upon the Lateral-Stability Characteristics of a Twin-Engine Airplane Model with Single Vertical Tails of Different Size. Marvin Pitkin. *U.S., N.A.C.A., Advance Restricted Report No. 3J18 (Wartime Report No. L-354)*, October, 1943. 26 pp., illus. 4 references.

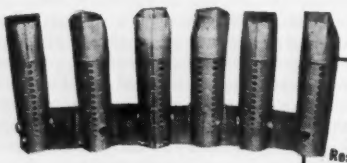
The Selection of Propellers for High Thrust at Low Airspeed. David Biermann and Robert N. Conway. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-483)*, October, 1941. 31 pp., illus. 2 references.

Aerodynamics and Flight Mechanics in the Development of Propellers. A. W. Quick. (*Deutsche Akademie der Luftfahrtforschung, Schriften 1063/43*, April 2, 1943.) *U.S., Army Air Forces, Translation No. F-TS-757-RE*, November, 1946. 60 pp., figs.

Counterrotating and dual-rotating propellers have advantages in improved flight characteristics that outweigh the disadvantages

WHEN EXTREME TEMPERATURES CALL FOR A COMBINATION OF PROPERTIES

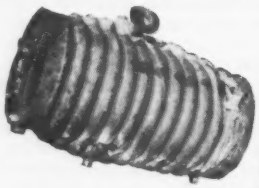
. . . Here's how Inconel*, one of the versatile Inco Nickel Alloys, provided 4 combinations of hard-to-find properties that solved 4 tough design problems.



PROPERTIES REQUIRED
Resistance to thermal shock.
Resistance to progressive oxidation.
Resistance to corrosion at high temperatures.
Fabricability and weldability.

JET ENGINES

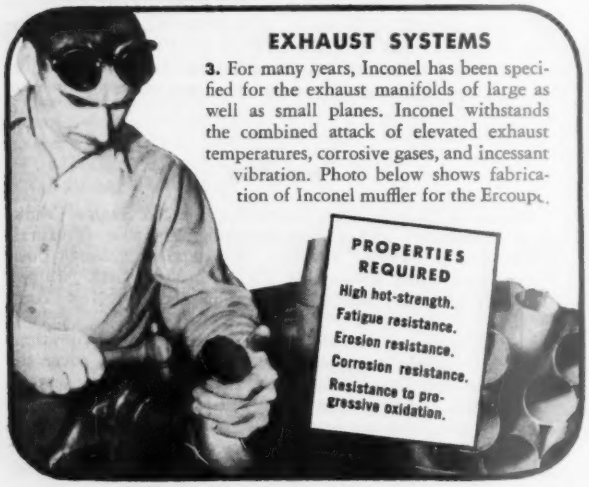
1. In designing jet engines to power America's newest, fastest pursuit planes, engineers chose Inconel* for the combustion chamber liner assemblies, as shown above. In all, 45 lbs. of .031" gauge Inconel strip is used per engine. Inconel's resistance to thermal shock plus its workability and weldability were important reasons why it was chosen for this demanding job.



PROPERTIES REQUIRED
Corrosion resistance at high temperatures.
Heat transfer.
Resistance to progressive oxidation.
Low coefficient of expansion.

CABIN HEATERS

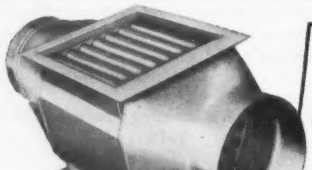
2. After 1100 hrs., this Inconel flash-type boiler was removed from an airliner and found to be in excellent condition. These boilers resist stack temperatures in excess of 1500° F. They withstand severe temperature extremes caused by 200° return water. And, they must remain free from scale and corrosion, in order to maintain clean surfaces for good heat transfer.



PROPERTIES REQUIRED
High hot-strength.
Fatigue resistance.
Erosion resistance.
Corrosion resistance.
Resistance to progressive oxidation.

EXHAUST SYSTEMS

3. For many years, Inconel has been specified for the exhaust manifolds of large as well as small planes. Inconel withstands the combined attack of elevated exhaust temperatures, corrosive gases, and incessant vibration. Photo below shows fabrication of Inconel muffler for the Ercoupe.

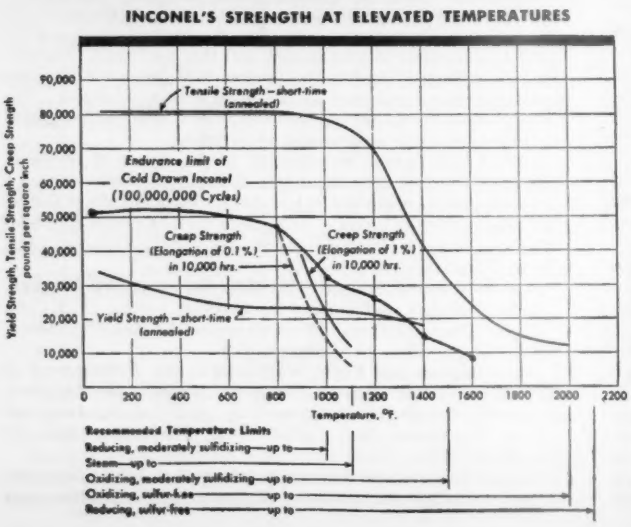


PROPERTIES REQUIRED
Heat transfer.
Corrosion resistance.
Resistance to thermal shock.
Fabricability.
Fatigue resistance.
Light weight.

DE-ICING EQUIPMENT

4. This McQuay heat exchanger, made entirely of Inconel, withstands the thermal shock of sub-zero intake air, and hot corrosive exhaust gases. Inconel also has strength to permit lightweight construction. Its ready workability enables it to be fabricated into the various parts required by this unit.

INCONEL'S STRENGTH AT ELEVATED TEMPERATURES



● Inconel's versatility plus its availability in standard forms, provide a ready solution for many difficult design problems.

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and the increased cost and complication of such installations. As a brake for diving and landing the propeller is satisfactory if it has adequate means for rapid and positive adjustment of the blades. To provide the best performance at sea level, in climbing, and at high altitudes the solution appears to call for the use of multispeed gearing that permits the choice of at least two rotational speeds. It may be possible to increase the efficiency of propellers when tip speeds approach the compressibility range by using extremely thin profiles, swept-back blades, slots, and other expedients. Propellers used in conjunction with turbojets may solve the question of propulsion at supersonic speeds.

Landing Brake Airscrews. D. de Villiers. *Aeronautics*, Vol. 16, No. 1, February, 1947, pp. 32–36, figs.

The various advantages and disadvantages of the landing-brake propeller are considered from a pilot's point of view. The assistance that a reversible-pitch propeller can afford a large flying boat maneuvering under tricky weather conditions at the slipway and mooring is well recognized. The advantage of the landing-brake propeller for landing on short runways and on slippery airfields where wheel brakes are virtually useless has been learned through personal experience. Reverse-thrust reaction is perhaps the most serious objection to the landing-brake propeller, but swing will not be experienced in multiengined aircraft equipped with counterrotating propellers or counterrotating engines, or in aircraft with tricycle landing gear and sensed throttle controls. Particulars and performance figures are given for the Lancaster experimental brake installation, certain other brake installations, details of control, and landing trials.

Wind-Tunnel Tests of Single- and Dual-Rotating Tractor Propellers at Low Blade Angles and of Two- and Three-Blade Tractor Propellers at Blade Angles Up to 65°. W. H. Gray. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-316)*, February, 1943. 22 pp., illus. 6 references.

The Characteristics of Two Model Six-Blade Counterrotating Pusher Propellers of Conventional and Improved Aerodynamic Design. James G. McHugh and Edward Pepper. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-404)*, June, 1942. 25 pp., illus. 6 references.

Lift and Drag Data for 30 Pusher-Propeller Shaft Housings on an NACA 65,3–018 Airfoil Section. Frank T. Abbott, Jr. *U.S., N.A.C.A., Advance Confidential Report No. 3K13 (Wartime Report No. L-299)*, November, 1943. 20 pp., figs. 4 references.

Moisture Transmission Through Plastic Films. K. MacKenzie. *Engineering Materials and Processes* (London), Vol. 4, No. 15, December, 1946, pp. 470–472.

The moisture transmission of thin layers of resins and plastics, applied to the surfaces of propellers of improved wood, was studied at relative humidities of 50–100 per cent and temperatures of 0°–40°C. A formula for determining the weight of moisture transmitted per unit of area was obtained, based on film thickness, temperature, vapor pressure, time, and a constant depending on the plastic used. Relative values of this constant are given for seven coatings.

Prop Balancing Simplified. *Aviation*, Vol. 46, No. 2, February, 1947, p. 61, illus.

A simplified method of statically balancing propellers in a horizontal position, requiring only a suspension point and a portable kit of equipment.

The Curtiss Propeller Synchronizer. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 73, 74, illus.

Automatically synchronized, constant-speed governing of all engines is provided by a single control lever in the cockpit, enabling the pilot to select the desired speed setting of all engines simultaneously. The master control is a constant-speed d.c. motor that is manually adjustable and can be located anywhere in the fuselage, and the electrical matching of speeds is accomplished by contactors mounted on and driven by the master motor. The equipment also provides reverse thrust, feathering, and selective fixed-blade angles.

Anticipation of Overspeeding; New de Havilland Pre-Setting Airscrew Governor. *Flight*, Vol. 51, No. 1990, February 13, 1947, p. 171, figs.

The governor anticipates the danger of overspeeding and prepares the constant-speed unit to react to the sudden rise in r.p.m. This is achieved by the addition of a mechanism that responds to the lack of oil pressure in the constant-speed unit following prolonged underspeeding, but which is normally held inactive by an auxiliary oil accumulator.

Radio

Radio Reception Interferences by the Ignition System. Partial Report I—Evaluation of Various Spark Plug Shieldings in Ultra-short-Wave Reception. Neubauer. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/PB/Re/383/1*, March, 1936.) *U.S., Army Air Forces, Translation No. F-TS-909-RE*, November, 1946. 9 pp., illus.

Investigations on Omnidirectional Antennas on a JU-88. S. Zisler. (*ZWB/UM/Re/636*, July, 1941.) *U.S., Army Air Forces, Translation No. F-TS-1067-RE*, February, 1947. 12 pp., figs.

Circuit for the Interference-Free Reception of Remote Control, Release, and Message Signals. Hoh. (*Wasserbau-Versuchsanstalt Kochelsee G.m.b.H., Archiv Nr. 181*, May 25, 1945.) *U.S., Army Air Forces, Translation No. F-TS-440-RE*, January, 1947. 9 pp., figs.

The operation of several circuits for interference-free reception is discussed in detail. Interference caused by electrical discharges such as lightning is the major consideration.

Echoes from the Atmosphere. *Bell Laboratories Record*, Vol. 25, No. 2, February, 1947, pp. 75–77, illus.

Radar signals observed near Chesapeake Bay and also on the Normandy coast of France could not be readily identified since neither aircraft nor birds were within range, but further tests with sound waves indicated that the echoes might be caused by hitherto unknown atmospheric differences in temperature and humidity that could be utilized in meteorology, radio, and fluid mechanics.

Printing Electronic Circuits. Cledo Brunetti and Philip J. Franklin. *U.S., National Bureau of Standards, Release No. ES-1049*, Recd. February 7, 1947. 7 pp.

The technique of printing components of electronic circuits by means of silver paint, carbon and resin mixtures, and other chemical processes on insulating plates such as steatite. The circuit plates are hardened by ceramic methods to make a simple and compact replacement for complicated layouts of wiring, resistors, inductors, condensers, and other electrical connections for instruments.

Production of Electron Beams of High Current Density. R. Hechtel. (*ZWB/RB/Re/1785*, June, 1943.) *U.S., Army Air Forces, Translation No. F-TS-1035-RE*, February, 1947. 28 pp., figs. 4 references.

Research

War Department Research and Development Program. *U.S., War Dept., General Staff*, 1947. 16 pp.

A tentative program outlines the major fields of research with which the Army is concerned and sets forth the objectives to be attained. The program is divided into sections dealing with guided missiles, medicine, ballistics, transportation, armament and explosives, military aircraft, navigation, communications, meteorology, atomic energy, photography, and personnel matters.

Boscombe Down: Work and Organization of the Aircraft and Armament Experimental Establishment. H. F. King. *Flight*, Vol. 51, No. 1985, January 9, 1947, pp. 29–35, illus.

Rotating Wing Aircraft

The Power Required of the Ideal Helicopter. K. Hohenemser. (*ZWB/TB/11–6*, June, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1045-RE*, January, 1947.

A brief synopsis of a treatise by G. Sissingh in TB Vol. 11, 1944, No. 3, p. 69, concerning the power requirements of a helicopter with respect to parasite drag of fuselage, disregarding the profile drag of the blade.

An Estimate of the Effect of Engine Supercharging on the Take-Off Thrust of a Typical Helicopter at Different Altitudes and Temperatures, TED No. NACA 1301. F. J. Bailey, Jr., and T. J. Voglewede. *U.S., N.A.C.A., Memorandum Report No. L5C12B (Wartime Report No. L-592)*, March, 1945. 10 pp., figs. 3 references.

Unstable Solutions of a Class of Hill Differential Equations. Gabriel Horvay. *Quarterly of Applied Mathematics*, Vol. 4, No. 4, January, 1947, pp. 385–396, tables.

The paper is based on a study undertaken at the McDonnell Aircraft Corporation which was prompted by instances of heli-

Experimental helicopter designed by United Helicopters, Inc., which utilizes jet thrust for rotor-torque correction.

copter control difficulties and rotor blade failures. Mathematical methods are developed by which the natural modes in which hinged rotor blades flap can be represented by solutions of a given equation multiplied by suitable damping factors.

Practical Engineering of Rotary Wing Aircraft. VIII. John E. McDonald. *Aviation*, Vol. 46, No. 2, February, 1947, pp. 58, 59, fig. (Cf. AER 3/47:81.)

An analysis is made of unstable speed ranges and damping requirements. A sample solution of a ground vibration problem is presented, in which the problem is to determine critical speed, center of unstable range, and magnitude of blade friction damping required to eliminate instability in a rotating wing aircraft having stated characteristics.

Charts for Helicopter-Performance Estimation. Herbert W. Talkin. *U.S., N.A.C.A., Advance Confidential Report No. L5E04 (Wartime Report No. L-283)*, August, 1945. 71 pp., figs. 8 references.

Helicopter Operation: Some Problems and Their Effect on Design Discussed: The Importance of Reducing Structure Weight. Reginald Brie. *Flight*, Vol. 51, No. 1987, January 23, 1947, pp. 89, 90, illus. (Extended abstract of a paper.)

Theory of Ground Vibrations of a Two-Blade Helicopter Rotor on Anisotropic Flexible Supports. Robert P. Coleman and Arnold M. Feingold. *U.S., N.A.C.A., Technical Note No. 1184*, January, 1947. 59 pp., figs. 5 references. (Cf. AER 2/47:27.)

Helicopter Engineering. Alexander Klemin. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 75, 142, map.

Post Office tests have established the feasibility and economy of using helicopters for local delivery of air mail. Tests made at Chicago, Los Angeles, and New York used helicopters of several makes, which flew shuttle routes from major airports to the vicinity of suburban post offices, thereby greatly accelerating the delivery of air mail at reasonable costs.

Operation Chicago. Don Terrio. *American Helicopter*, Vol. 5, No. 3, February, 1947, pp. 22, 23, 45, illus.

U.S. Coast Guard Helicopter Program. Joseph F. Farley. *American Helicopter*, Vol. 5, No. 3, February, 1947, pp. 14, 34, illus.

Increased efficiency is expected by using helicopters at lifeboat stations, on board Coast Guard cutters, in ice operations, disaster relief, servicing navigational aids, and routine patrols.

Historical Development of Helicopters. I. R. N. Liptrot. *American Helicopter*, Vol. 5, No. 3, February, 1947, pp. 12, 13, 35–37, illus. (Cf. AER 2/47:68.)

German Aircraft in Detail. VII—The Doblhoff WNF 342. *The Aeroplane Spotter*, Vol. 8, No. 179, January 11, 1947, p. 5, illus.

Four types of jet-rotor helicopters were developed during the war, of which the final design, the V-4, used a 140-hp. Siemens-Halske Sh 14A engine to drive the compressor supplying power for jets in the rotor tips and to turn a fixed-pitch propeller for forward motion. Another propeller mounted coaxially with the propulsion propeller provided a slipstream to act on the rudder for directional control when hovering.

The "Gyrodyne" Helicopter. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 76, 142, illus.

J. A. Bennett has designed a rotating wing aircraft, the Fairey FB-1, in which lift is provided by a power-driven rotor while an offset propeller exerts forward thrust for propulsion and torque neutralization. A single engine powers both the rotor and the propeller, through the use of a clutch and differential gearing.

The German Kite (Rotating-Wing). James J. Rodgers. *American Helicopter*, Vol. 5, No. 3, February, 1947, pp. 10, 11, 33, 34, illus. (Cf. AER 1/47:59.)

The Sikorsky HO2S-1. *The Aeroplane*, Vol. 72, No. 1859, January 10, 1947, p. 39, illus. Descriptive, with detailed specifications and performance characteristics.

Operating Helicopters Commercially. George Herrick. *Air Transport*, Vol. 5, No. 2, February, 1947, pp. 42–44, illus.

Figures on the cost of operating helicopters commercially, as determined from the experience of Helicopter Air Transport, which is flying passengers and cargo with a fleet of five rotary wing aircraft.

Seaplanes and Flying Boats

Static Stability Analysis for Flying Boats and Seaplanes. III. Ernest G. Stout. *Aviation*, Vol. 46, No. 2, February, 1947, pp. 55–57, figs. (Cf. AER 3/47:83.)

Float design and required float displacement are discussed. The conditions that a good float must satisfy are enumerated. Basic principles established by laboratory and flight-testing experience which should serve as a guide to float design are set forth.

Scale Effect and Optimum Relations for Sea Surface Planing. L. Sedov. *(Tsentral'nyi Aero-Gidrodinamicheskii Institut, Mos-*

cow, Trudy No. 439, 1939.) *U.S., N.A.C.A., Technical Memorandum No. 1097,* February, 1947. 36 pp., figs. 9 references.

From the general dimensional and mechanical similarity theory it follows that a condition of steady motion of a given shape bottom with constant speed on the surface of water is determined by four nondimensional parameters. By considering the various systems of independent parameters which are applied in theory and practice and in special tests, their mutual relations and their suitability as planing characteristics are determined. The data obtained by computation are in good agreement with the test results.

Measurements of Wetted Hull Bottom of Seaplanes During Take-Offs and Landings. Vogel. (*Deutsche Versuchsanstalt für Luftfahrt, Institut für Seeflugwesen, Hamburg, ZWB/FB/1787,* April, 1943.) *U.S., Army Air Forces, Translation No. F-TS-1057-RE,* December, 1942. 70 pp., figs.

For the theoretic calculation of landing and take-off of seaplanes an instrument was devised for measuring the wetted area and contour of the hull surface, and water pressure. Its function and use are described in detail. This instrument functioned satisfactorily on a BV-138A flying boat. Results of tests are evaluated.

Recent Developments in Flying-Boats. I, II, III. Henry Knowler. *The Engineer,* Vol. 183, Nos. 4750, 4751, 4752, January, 24, 31, February 7, 1947; pp. 91–93, figs.; pp. 117, 118, illus.; pp. 140, 141, illus.

I. A discussion of design factors peculiar to flying boats deals with the general considerations affecting the design. Following some brief remarks regarding the weight of components and the drag of a flying-boat hull, consideration is given to hull design, which must meet three main requirements, namely: low water resistance, stability throughout the take-off run, and clean running, or freedom from high-thrown spray. II. Following a discussion of the materials used in flying boats, details are given about hull construction, the advantages and objections to different types of power plant, and maintenance considerations. III. The handling of flying boats, both on the water and on land, is discussed and trends in design are reviewed.

Flying-Boats. *Flight,* Vol. 51, Nos. 1989, 1990, February 6, 13, 1947, pp. 131–136, illus.; Discussion, p. 164. (Extended abstracts of two papers: Recent Developments in Flying Boats, Henry Knowler (*see* preceding abstract). The Flying-Boat and Its Commercial Future, Peter Masefield (*see* AER 3/47:37).

Flying Boat Revival Apparent in England. Ronald A. Keith. *Canadian Aviation,* Vol. 20, No. 2, February, 1947, pp. 32, 70.

Flying boat activities in England are reviewed. Comments are made on design features of the Saunders-Roe SR-45 high-wing, six-engined project. Limiting factors that will determine the size of the flying boat are considered, and also the prospects for freighter flying boats for Atlantic service.

Hydrodynamic-Stability Tests of a Model of a Flying Boat and of a Planing Surface Having a Small Downward Projection (Hook) on the Planing Bottom Near the Step. James M. Benson. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. L-518),* January, 1943. 6 pp., figs. 4 references.

General Resistance Tests on Flying-Boat Hull Models. F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 4B19 (Wartime Report No. W-70),* February, 1944. 26 pp., figs. 9 references.

Some Systematic Model Experiments of the Bow-Spray Characteristics of Flying-Boat Hulls Operating at Low Speeds in Waves. F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 3L04 (Wartime Report No. W-71),* December, 1943. 39 pp., illus. 3 references.

A Method for Making Quantitative Studies of the Main Spray Characteristics of Flying-Boat Hull Models. F. W. S. Locke, Jr., and Helen L. Bott. *U.S., N.A.C.A., Advance Restricted Report No. 3K11 (Wartime Report No. W-69),* November, 1943. 41 pp., illus. 11 references.

A Method for Studying the Longitudinal Dynamic Stability of Flying-Boat-Hull Models at High Planing Speeds and During Landing. F. W. S. Locke, Jr., and W. C. Hugli, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 4H31 (Wartime Report No. W-57),* April, 1945. 38 pp., illus. 5 references.

Some Yawing Tests of a 1/30-Scale Model of the Hull of the XPB2M-1 Flying Boat. F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 3G06 (Wartime Report No. W-66),* July, 1943. 20 pp., figs. 2 references.

The Landing Stability of a Powered Dynamic Model of a Flying Boat with a 30° V-Step and with Two Depths of Transverse Step. John B. Parkinson and Norman S. Land. *U.S., N.A.C.A., Restricted Bulletin No. 4B14 (Wartime Report No. L-236),* February, 1944. 7 pp., figs. 3 references.

"General" Main-Spray Tests of Flying-Boat Models in the Displacement Range. F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 5A02 (Wartime Report No. W-72),* April, 1945. 19 pp., figs. 4 references.

The Effects of Angle of Dead Rise and Angle of Afterbody Keel on the Resistance of a Model of a Flying-Boat Hull. Joe W. Bell and John M. Willis, Jr. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-305),* February, 1943. 43 pp., illus. 5 references.

Some Analyses of Systematic Experiments on the Resistance and Porpoising Characteristics of Flying-Boat Hulls. Kenneth S. M. Davidson and F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 3I06 (Wartime Report No. W-68),* September, 1943. 46 pp., illus. 3 references.

Porpoising; A Comparison of Theory with Experiment. Kenneth S. M. Davidson, F. W. S. Locke, Jr., and Anthony Suarez. *U.S., N.A.C.A., Advance Restricted Report No. 3G07 (Wartime Report No. W-65),* July, 1943. 42 pp., figs. 4 references.

Some Systematic Model Experiments on the Porpoising Characteristics of Flying-Boat Hulls. Kenneth S. M. Davidson and F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 3F12 (Wartime Report No. W-67),* June, 1943. 73 pp., illus. 9 references.

The Effect of Dead Rise upon the High-Angle Porpoising Characteristics of Two Planing Surfaces in Tandem. James M. Benson and Milton M. Klein. *U.S., N.A.C.A., Advance Restricted Report No. 3F30 (Wartime Report No. L-306),* June, 1943. 23 pp., figs. 6 references.

Tank Tests on the Resistance and Porpoising Characteristics of Three Flying-Boat Hull Models Equipped with Planing Flaps. F. W. S. Locke, Jr., and Jean A. Barklie. *U.S., N.A.C.A., Advance Restricted Report No. 4H30 (Wartime Report No. W-58),* November, 1944. 50 pp., figs. 6 references.

Notes on the Skipping of Seaplanes. John B. Parkinson. *U.S., N.A.C.A., Restricted Bulletin No. 3I27 (Wartime Report No. L-333),* September, 1943. 12 pp., figs.

Mooring and Docking of Flying-Boats (Saunders-Roe Automatic Pick-Up). *Aeronautics,* Vol. 16, No. 1, February, 1947, p. 50, fig. (Cf. AER 1/47:43.)

Float Facts. Elmer J. Clinton. *Flying,* Vol. 40, No. 3, March, 1947, pp. 38–40, 82, 84, illus.

Information about the design requirements for floats, the safety requirements prescribed by Civil Aeronautics regulations, problems of manufacture, and the features of Edo floats.

Stress Analysis and Structures

Numerical Procedures for Calculation of Stress Distribution in Sheet-Stringer-Frame Combinations. Marvin Stern. *Republic Aviation Corp.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, April, 1947.)

Tensor Analysis of Aircraft Structural Vibration. Charles E. Mack, Jr. *Grumman Aircraft Engineering Corp.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, April, 1947.)

Investigations of 24S-T Riveted Tension Joints. R. L. Fefferman and H. L. Langhaar. *Journal of the Aeronautical Sciences,* Vol. 14, No. 3, March, 1947, pp. 133–147, figs. 6 references.

Test data are given, in duplicate, for approximately 110 distinct tension joints that were formed by uniting 24S-T sheets with protruding-head rivets. With the aid of a general empiric "stress-concentration" factor, the data are well correlated with a modified form of the elementary theory of tension joints. The modification lies in the assumption that rivets of unequal diameter in a joint carry equal bearing stresses, rather than equal shearing stresses, when the ultimate load is approached. Extensive data are given to demonstrate that this is a good approximation for the case of 17S-T rivets in 24S-T sheets. An algebraic formulation of the elementary theory is presented for the purpose of rendering the problem of optimum proportions of a multiple-row joint accessible to mathematical analysis. Explicit rules are developed for laying out efficient joints.

Beam-Columns. Wm. R. Osgood. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 167–170, fig. 3 references.

A method of designing beam-columns is presented which appears to be both safe and economical. The method consists of two steps. (1) The given transverse load is replaced by two equal and opposite couples equal to the maximum bending moment produced by the transverse load acting alone. The two couples act at such sections that they produce the same maximum deflection at the same section as the given transverse load acting alone. (2) The two couples and the given axial load are now replaced by eccentrically applied loads at the ends which produce the same maximum bending moment as the couples and the axial load acting alone.

The General Variational Principle of the Theory of Structural Stability. William Prager. *Quarterly of Applied Mathematics*, Vol. 4, No. 4, January, 1947, pp. 378–384.

The general problem of structural stability in the elastic or plastic range is examined. Two slightly different formulations of this problem are found in the literature on the subject. In the one adopted in this analysis the investigator considers a given configuration of a deformable body and an equilibrium system of body and surface stresses and asks whether, in the presence of these initial stresses, the given configuration is stable or not. Stress-strain relations enter into the discussion at one point only, that is, it is necessary to be able to predict the infinitesimal changes in stress which correspond to the infinitesimal strains associated with a system of infinitesimal displacements from the considered equilibrium configuration. The general problem of structural stability is reduced to an eigen-value problem for the displacements from a configuration of indifferent equilibrium to a neighboring configuration of this type. Except for the consideration of plastic deformations, the methods of Beizeno and Henchy are followed in this derivation, but the discussion is simplified by the systematic use of tensors.

Stresses Around Rectangular Cut-Outs with Reinforced Coaming Stringers. Paul Kuhn, Norman Rafel, and George E. Griffith. *U.S., N.A.C.A., Technical Note No. 1176*, January, 1947. 21 pp., illus. 2 references.

An earlier method for calculating the stresses around rectangular cutouts in skin-stringer panels is extended to panels in which the coaming stringers (stringers bordering the cutout) are reinforced in the region of the cutout and are tapered to the basic stringer section. Strain measurements and strength tests were made on six skin-stringer panels under axial load. Three of these panels had short rectangular cutouts and three had long ones; the width of cutout was about one-half the width of the panel. Three types of coaming stringers were used: without reinforcement, with riveted-up reinforcement, or with integral reinforcement. The strain measurements were found to be in good agreement with a previously published theory, adapted where necessary by making overlapping assumptions. The tests as well as the analysis cover the elastic range and the ultimate load.

The Buckling of a Flat Rectangular Plate Under Axial Compression and its Behaviour After Buckling. H. L. Cox. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2041*, May 7, 1945. 28 pp., figs. 4 references. British Information Services, New York. $1.50.

An attempt is made to assess the relative importance of the several factors that influence the buckling of the plate, with respect to the probable range of variation of these factors in practical structures. The buckling stress of a flat rectangular plate may be determined chiefly by the degree of restraint applied to its edges against rotation; but restraint against movement of the edges in the plane of the plate may also have considerable influence. In their effects on the behavior of the plate after buckling both types of restraint are equally important; in particular, lateral restraint may occasionally cause the plate to behave in an apparently anomalous manner.

Creep Deflections in Columns. Joseph Marin. *Journal of Applied Physics*, Vol. 18, No. 1, January, 1947, pp. 103–109, figs. 3 references.

Available theories for the determination of column deflections and column buckling loads do not provide for materials that creep with time under constant loads. Plastics, concrete, and some metals creep at normal temperatures while other metals creep only at high temperatures and at stress values beyond the yield point. A consideration of creep in the design of some structures appears appropriate in view of the modern developments in plastics and the presence of high stress values that are sometimes beyond the yield stress. A rational theory for predicting creep deflections in columns is presented. A special case using this theory is applied to the interpretation of some preliminary tests of an aluminum alloy.

Numerical Solution of Axisymmetrical Problems, with Applications to Electrostatics and Torsion. George Shortley, Royal Weller, Paul Darby, and Edward H. Gamble. *Journal of Applied Physics*, Vol. 18, No. 1, January, 1947, pp. 116–129, figs. 54 references.

An extension of numerical methods for handling partial differential equations in two dimensions. A complete computation of the stresses and strains in a grooved circular shaft under torsion is presented.

Note on a Boundary Value Problem of Reissner and Sagoci. Ian N. Sneddon. *Journal of Applied Physics*, Vol. 18, No. 1, January, 1947, pp. 130–132. 6 references.

A further consideration of the problem in which it is required to determine the components of stress and of the displacement vector in the interior of a semi-infinite, homogeneous, isotropic, elastic solid when a circular area of the surface is forced to rotate through an angle about an axis which is normal to the undeformed surface of the medium. In this paper the problem is reduced to the solution of a pair of dual integral equations.

Testing Machines. (*Carl Schenck Maschinenfabrik G.m.b.H., Darmstadt.*) *U.S., Army Air Forces, Translation No. F-TS-782-RE*, January, 1947. 9 pp., illus.

The flexure and torsion machine was designed for testing of alternate bending stress and alternate torsional stress endurance. The pulsator serves for endurance tests on materials and component parts by increasing or changing the tension pressure forces. The valve-spring testing machine automatically rejects those with minor defects and selects those with suitable physical characteristics.

Description of a Slope Recorder and an Elliptic Enlarger. *Netherlands, Nationaal Luchtvaartlaboratorium, Report No. S.316*, November, 1946. 12 pp., diagrs. (In English.)

An instrument is described by means of which the slope in a section of a buckled plate can be recorded as a function of the length coordinate of the section, and by which profile recordings also can be obtained. An elliptic enlarger provides improved pictures for evaluating test results.

Photogrid Process Applied to Problems in Machine Design. G. A. Brewer. *Machine Design*, Vol. 19, No. 2, February, 1947, pp. 120–122, illus. 9 references.

This process, used for the determination of plastic strains over almost any size gage length, is particularly useful in the study of strains in the neighborhood of discontinuities, such as holes in a structure, or of strains encountered during forming operations. The process consists of spraying a photosensitive glue onto the surface of a piece of metal and then, by exposure to light, printing a gridwork of lines on the surface of the specimen. Typical applications of the process and the preparation of the spraying emulsion are described.

A Method of Shear-Lag Analysis of Box Beams for Axial Stresses, Shear Stresses, and Shear Center. Oscar Erlandsen, Jr., and Lawrence M. Mead, Jr. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. W-33)*, April, 1942. 60 pp., figs. 12 references.

The Influence of Bulkhead Spacing on Bending Stresses due to Torsion. Paul Kuhn. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-501)*, May, 1942. 16 pp., illus. 3 references.

Early Detection of Cracks Resulting from Fatigue Stressing. John A. Bennett. *U.S., N.A.C.A., Restricted Bulletin No. 4I15 (Wartime Report No. W-78)*, September, 1944. 7 pp., figs. 1 reference.

A Method of Calculating Bending Stresses Due to Torsion. Paul Kuhn. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-352)*, December, 1942. 40 pp., figs. 3 references.

An Approximate Method of Shear-Lag Analysis for Beams Loaded at Right Angles to the Plane of Symmetry of the Cross Section. Paul Kuhn and Harold G. Brilmyer. *U.S., N.A.C.A., Restricted Bulletin No. 3I22 (Wartime Report No. L-324)*, September, 1943. 12 pp., figs. 2 references.

Compressive Strength of Flat Panels with Z-Section Stiffeners. Carl A. Rossman, Leonard M. Bartone, and Charles V. Dobrow-

ski. *U.S., N.A.C.A., Advance Restricted Report No. 4B03 (Wartime Report No. L-499)*, February, 1944. 18 pp., illus. 3 references.

Tests of 10-Inch 24S-T Aluminum-Alloy Shear Panels with $1^1/_2$-Inch Holes. Paul Kuhn and L. Ross Levin. *U.S., N.A.C.A., Restricted Bulletin 3F29 (Wartime Report No. L-500)*, June, 1943. 13 pp., illus. 2 references.

Comparison of an Approximate and an Exact Method of Shear-Lag Analysis. John E. Duberg. *U.S., N.A.C.A., Advance Restricted Report No. 4A18 (Wartime Report No. L-310)*, January, 1944. 19 pp., figs. 6 references.

The Strength and Stiffness of Shear Webs with Round Lightening Holes Having 45° Flanges. Paul Kuhn. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-323)*, December, 1942. 25 pp., illus. 1 reference.

Stresses Around Rectangular Cut-Outs in Skin-Stringer Panels Under Axial Loads. II. Paul Kuhn, John E. Duberg, and Simon H. Diskin. *U.S., N.A.C.A., Advance Restricted Report No. 3J02 (Wartime Report No. L-368)*, October, 1943. 78 pp., illus. 4 references.

The Fatigue Characteristics of Bolted Lap Joints of 24S-T Alclad Sheet Materials. L. R. Jackson, W. M. Wilson, H. F. Moore, and H. J. Grover. *U.S., N.A.C.A., Technical Note No. 1030*, October, 1946. 129 pp., illus. 6 references.

Fatigue tests were conducted to determine the effect of bolt fit upon the lifetime of lap joints of 24S-T Alclad sheet of various thicknesses joined by steel bolts and designed for sheet failure under repeated loading. Tests were run in tension-tension and in tension-compression on specimens joined by one bolt and on specimens joined by several bolts having uniform fit (for any one specimen). It appears that bolt fit has no pronounced influence on joint lifetime under unidirectional loading. The direct influence of bolt fit on lifetime under reversed loading also seems to be slight. While, from these tests, bolt fit does not appear to influence fatigue strength, it should be emphasized that loose-fitting bolts permit objectionable slip and joint deflection and are undesirable, especially for joints under reversed loading. The use of two or more bolts in line with the load increases the fatigue strength, but not in proportion to the number of bolts used. For a given bolt diameter and a given bolt pattern, the fatigue strength of bolted lap joints does not increase in proportion to the sheet gage used.

Fatigue Strength and Related Characteristics of Joints in 24S-T Alclad Sheet. H. W. Russell, L. R. Jackson, H. J. Grover, and W. W. Beaver. *U.S., N.A.C.A., Advance Restricted Report No. 4E30 (Wartime Report No. W-63)*, May, 1944. 59 pp., illus. 3 references.

Fatigue Strength and Related Characteristics of Spot-Welded Joints in 24S-T Alclad Sheet. H. W. Russell. *U.S., N.A.C.A., Advance Restricted Report No. 3L01 (Wartime Report No. W-61)*, December, 1943. 55 pp., illus. 1 reference.

Fatigue Strength and Related Characteristics of Aircraft Joints. I—Comparison of Spot-Weld and Rivet Patterns in 24S-T Alclad Sheet—Comparison of 24S-T Alclad and 75S-T Alclad. H. W. Russell, L. R. Jackson, H. J. Grover, and W. W. Beaver. *U.S., N.A.C.A., Advance Restricted Report No. 4F01 (Wartime Report No. W-56)*, December, 1944. 73 pp., illus. 5 references.

Comparative Fatigue Tests of Riveted Joints of Alclad 24S-T, Alclad 24S-T81, Alclad 24S-RT, Alclad 24S-T86, and Alclad 75S-T Sheet. R. L. Moore and H. N. Hill. *U.S., N.A.C.A., Restricted Bulletin No. 5F11 (Wartime Report No. W-76)*, August, 1945. 11 pp., illus.

Fatigue Strength of Flush-Riveted Joints for Aircraft Manufactured by Various Riveting Methods. G. A. Maney and L. T. Wyly. *U.S., N.A.C.A., Advance Restricted Report No. 5H28 (Wartime Report No. W-82)*, December, 1945. 23 pp., illus. 7 references.

Test Data on the Shear Strength of Joints Assembled with Round-Head and Brazier-Head Rivets. Merven W. Mandel and Evan H. Schuette. *U.S., N.A.C.A., Restricted Bulletin No. 3F21 (Wartime Report No. L-519)*, June, 1943. 10 pp., figs.

A Preliminary Study of Machine-Countersunk Flush Rivets Subjected to a Combined Static and Alternating Shear Load. Harold Crate. *U.S., N.A.C.A., Restricted Bulletin No. 3L01 (Wartime Report No. L-495)*, December, 1943. 10 pp., illus. 3 references.

Mechanical Properties of Flush-Riveted Joints Submitted by Five Airplane Manufacturers. Progress Summary No. 1. William Charles Brueggeman. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. W-79)*, February, 1942. 36 pp., illus.

Wind Tunnels and Laboratories

Wind-Tunnel Turbulence Effects. Dimitri P. Riabouchinsky. *Journal of the Aeronautical Sciences*, Vol. 14, No. 3, March, 1947, pp. 190–192, figs. 19 references.

Early research work on wind-tunnel turbulence effects threw light upon certain peculiarities of different types of wind tunnels; the relationship of linear dimensions of a body to the stream section of the tunnel; means of supporting the body in the stream; and the degree of turbulence in the stream. Comments are made on later research and the application of the results to current knowledge of turbulence.

Balance for Wind Tunnel Tests. A. B. Asch. *Aero Digest*, Vol. 54, No. 2, February, 1947, pp. 68, 69, 134, 135, illus.

An automatic and remote-indicating wind-tunnel balance built by Taller & Cooper Co. consists of a cradle frame, floated on automatic weigh-beam scales, designed to measure three forces and three moments and to control and indicate the angles of pitch and yaw of aircraft models. Measurements are simplified by an integrating unit which adds and subtracts mixed values to obtain desired values that otherwise would require lengthy mathematical computation.

Organization, Facilities, and Research Output of the Airplane Examination Plant, Civil Aeronautics Bureau, Japanese Ministry of Transportation. A. L. Lowell. *U.S., Army Air Forces, Intelligence Review No. F-IR-134-RE*, January, 1947. 68 pp., figs. 74 references.

The Airplane Examination Plant has ordinary testing equipment, although of small scale. With the extension of the war, inspection of newly constructed machines was reduced because civil training and transport aircraft were inspected by military agencies. The work of this organization was then directed mainly toward the periodic and incidental inspection of civil aircraft in use. Although the establishment is not primarily a research institute, it has attempted to carry on research work directed toward increasing the safety of air traffic and toward evolving a scientific approach to the economics of air transportation. The equipment in the plant is listed and described, and brief annotations are included of 74 reports (in Japanese), of which eleven are abstracted. The reports are classified under a general heading, and also under aerodynamics, structures, instruments, electrical equipment, and materials.

Home of 'The Impossible.' Margarita Dobert. *Flying*, Vol. 40, No. 3, March, 1947, pp. 32–34, 98, 99, illus. Particulars of the proposed research center of the A.A.F.

The Application of Microwaves to Instrument Landing of Airplanes

(*Continued from page 27*)

A set of twelve specifications defining the objectives of the research and development activities are listed and discussed in detail.

Mr. Lyman points out that in writing this paper he is merely the spokesman for many. Frederick A. Jenks, Sigurd Varian, Donald Follard, Thomas Ferrill, William Ratliff, George A. Weis, George B. Litchford, and Carl A. Frische have each individually made outstanding contributions to the development of a new art—continuous-wave microwave technique for air navigation. Separately, little would have been accomplished. By working together with enthusiasm and mutual respect over a period of years, results achieved have been far greater than the sum of their respective efforts.

Long-distance Television is twenty years old

At the 1927 demonstration, Dr. Herbert E. Ives explained the television system developed in Bell Telephone Laboratories.

April 7 is a notable day in communication history, for on that day in 1927 was the first demonstration of television over long distances. Large-scale images were flashed from Washington, D.C., by wire and from Whippany, N.J., by radio to a public demonstration in New York City. "It was," said a newspaper, "as if a photograph had suddenly come to life and begun to smile, talk, nod its head and look this way and that."

That was the first of many public demonstrations, each to mark an advance in the television art. In 1929 came color television, and in 1930 a two-way system between the headquarters buildings of A. T. & T. and Bell Laboratories. When the first coaxial cable was installed in 1937, television signals for 240-line pictures were transmitted between Philadelphia and New York and three years later 441-line signals were transmitted. By May, 1941, successful experiments had been made on an 800-mile circuit.

End of the war brought a heightened tempo of development. Early in 1946 began the regular experimental use of coaxial cable for television between New York and Washington, and a few months later a microwave system for television transmission was demonstrated in California.

Transmission facilities will keep pace as a great art advances to wide public usefulness.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Books

All of the books reviewed and listed are in the I.A.S. Library and may be borrowed without charge, except for certain reference books. Application for loans should be made to The Paul Kollsman Lending Library, 2 East 64th Street, New York 21, N.Y.

Matrix and Tensor Calculus, with Applications to Mechanics, Elasticity, and Aeronautics. Aristotle D. Michal. New York, John Wiley & Sons, Inc., 1947. 132 pp. $3.00.

This book is based on a series of lectures given by the author under the sponsorship of the Engineering, Science, and Management War Training program in 1942 and 1943. The first part deals with matrix calculus, which, as an analytic and algebraic subject is distinguished by the author from the tensor calculus of the second part, which is geometric in character. Following the plan of emphasizing fundamentals and presenting basic mathematical concepts first, the author begins with algebraic preliminaries, and continues into the differential and integral calculus of matrices. Applications of matrix methods to problems of small oscillations, the mathematical theory of aircraft flutter, and elastic deformation theory conclude the first part. The last two-thirds of the book is devoted to tensor calculus and its applications. The space line element in curvilinear coordinates, vector fields, tensor fields, Euclidean Christoffel symbols, tensor analysis, Laplace's equation, the wave equation, and Poisson's equation in curvilinear coordinates are discussed in the first four chapters. Elementary applications of the tensor calculus to hydrodynamics, and applications to strains and stress-strain relations are next taken up. The Riemannian tensor analysis is discussed, and is applied in the final chapter to boundary-layer theory, including previously unpublished work by Dr. C. C. Lin on boundary-layer equations for the steady motion of a homogeneous incompressible fluid. At the end of the book there are useful notes on each chapter containing additional material, lists of more than 90 references, and a good index. This is the latest addition to the Galcit Aeronautical Series under the auspices of the Guggenheim Aeronautical Laboratory of the California Institute of Technology, where the author is a professor of mathematics. An editor's preface is contributed by Drs. Theodore von Kármán and Clark B. Millikan.

Elementary Theory of Gas Turbines and Jet Propulsion. J. G. Keenan. London, New York, Oxford University Press, 1946. 261 pp., illus. $5.00.

The author points out that gas turbine practice is not yet sufficiently standardized to make possible the compilation of a comprehensive textbook, but he has rendered a service in presenting the basic principles simply, using only mathematical essentials. The concept of entropy, for example, has been omitted in the interest of simplicity, and the theory is based entirely on pressure-volume considerations. The first chapters deal with the history of the gas turbine from the seventeenth century to Whittle, the physics of gases, and gas-turbine cycles. The author points out that much of the material used has been available in published form. For example, material for the chapters on nozzles, impulse turbines, and reaction turbines has been largely derived from data available on steam turbines. Previous work on superchargers and on industrial blowers furnishes a basis for the theory of the centrifugal compressor. Axial-flow compressors, combustion chambers, and heat exchangers are discussed in the light of known theory and practice. The final chapters deal with gas-turbine efficiencies and the application of the gas turbine to aircraft jet propulsion. Various combinations, both existing and projected, of installations for aircraft propulsion are discussed. The impulse-duct jet motor and the constant-pressure duct jet motor (pulse-jet and ram-jet, respectively, in American terminology) receive necessarily brief treatment since there is relatively little available experimental data on them. Applications of gas turbines for railway locomotives, ships, and electric generating stations are included. There are footnote references to sources and the book has a good index. This should be a useful source of study for the engineering student and for engineers wishing to review the subject.

Précis de Mécanique des Fluides à L'Usage des Ingénieurs (Outline of Fluid Mechanics for Engineers). Marcel Sédille. Paris, Dunod, 1944. 138 pp., diagrs.

The purpose of this work, as stated in the preface by Dr. Maurice Roy, is to fill a gap existing in French engineering literature and to provide engineers with a selected body of information on the laws and results of a science that has progressed rapidly in the last 30 years. Research at the Société Rateau, of which the author is chief engineer, is the basis for the book in which the most recent theories are presented in as simple a form as possible, with mathematics reduced to a minimum. Following an introductory discussion in which there is a review of the mechanics of perfect fluids, there is a study of the influence of the Reynolds' Number on flow around obstacles. Other major sections cover turbulent and laminar flow, similarity, surface roughness, vortexes, separation, compressible fluids and heat exchange. To simplify the presentation it was restricted to movement of two dimensions wherever possible. An exception is the chapter on turbulence in which three-dimensional movement had to be introduced.

Airway Manual; Up to Date Airway Data Designed Primarily for Instrument Avigation. United States and Canada Coverage. Denver, Jeppesen & Co., 1947. 2 v. Diagrs. Loose-leaf. $69.40 including 1 year's weekly revision service; $107.95 including 2 years' weekly revision service.

This standard flight manual is available in a wide variety of specially assembled editions, covering routes and airports in North America or routes overseas, ranging from limited areas to complete coverage. The first volume contains instrument avigation charts, radio procedure charts, general radio direction finding facilities, airports without range facilities, meteorology data, avigation data, and a section on airway traffic control. Plan views give the pilot a continuous picture of his route in areas 350 miles wide and 615 miles long. These are accompanied by mileage charts showing distances in statute and nautical miles between radio facilities, radio-range leg intersections, reporting points, fan markers, and other radio fixes. For each plan view and mileage chart, a terrain profile gives the picture of altitudes along the route in 20-mile and 40-mile-wide cross sections.

Radio procedure charts are designed to enable the pilot to follow a safe procedure in letting down to an authorized minimum ceiling at an airport located in the vicinity of a radio station and if contact flight is not established, to make a safe pull-up. Listings of air-navigation radio facilities by frequency, identification, and locality; and commercial broadcasting stations by frequency, call letters, locality, and by states, with bearing and distances to the nearest airports are included. There is an index of all airports referred to in the manual. For those with no range facilities a plan is given, and the elevation, latitude and longitude, length of runways, surface, lights, and obstructions are shown. Charts of C.A.A. teletype areas are given in the meteorology section, showing sequence of collection, relays, location of reporting office, map signals, and instructions for interpreting teletype reports. The first volume ends with a digest of general navigation formulas, tables, rules, and procedures, and a condensation of airway traffic control regulations and procedures, graphically illustrated. Volume 2 contains radio procedure charts for more than 1,200 major airports for the United States and Canada, including military airports and the more important private and auxiliary fields. Airport dimensions, lights, obstructions, tower frequencies, and other data are given. The charts show range and communication frequencies, safe altitudes within 25, 50, and 100 mile radiuses, step-down approach altitudes, graphic presentation of standard letdown procedure, terrain characteristics and obstructions, and standard missed approach or pull-up instructions. The weekly revision service of the manual is made possible by the use of a wide range of information sources.

Moteurs d'Avions (Aircraft Engines). R. Marchal. Paris, Dunod, 1946. 2 v. 643, 99 pp.

Several characteristics of this work as stated in the introduction are: mathematical strictness subordinated to simplicity of expression; emphasis on the fundamentals of the internal-combustion engine with less attention to certain secondary aspects; and restraint in presenting technological developments since students have opportunity for practical work on actual engines. The author was a director of engine construction for 6 years, and this volume is the result of courses taught at the École Nationale Supérieure de l'Aéronautique. It is also stated that calculation of balance, research on critical speeds, and certain kinematic developments have been omitted. The first chapter is a condensed, classified dictionary of terms connected especially with weight, power, and output. The material of construction is given for parts mentioned and there are several useful diagrams. The discussion begins in the next chapter which includes thermodynamics of engines; fluids; theoretic and actual cycle of four-stroke engines; compressor, output, power variations, atmospheric conditions, speed and altitude; the six-stroke engine; and internal thermo- and aerodynamics. This presentation is intended to permit the calculation of dimensions of engines for given conditions. There follow methods of calculation of essential parts by applying methods of resistance of materials in connection with cylinder gases as discussed in chapter two, and as applied especially to the connecting rod assembly. The next three chapters cover problems connected with combustible mixtures; carburetors, pumps, and injectors, and their regulation; ignition and its parts; and lubrication. They are followed by chapters on thermal equilibrium and heat exchange, conduction, liquid and air cooling; principal arrangements in engines, kinematics, mechanics, dynamics, thermodynamics, thermochemistry, and external and internal aerodynamics. Three chapters present the construction of engines, manufacturing methods, controls, standardization, installation, maintenance and repair; tests; methods and equipment for adaptation, installation, and accessories. The final chapter discusses proposals and experiments that were never put into practice. Volume 2 consists mainly of charts showing variations in functions. It also contains some power curves

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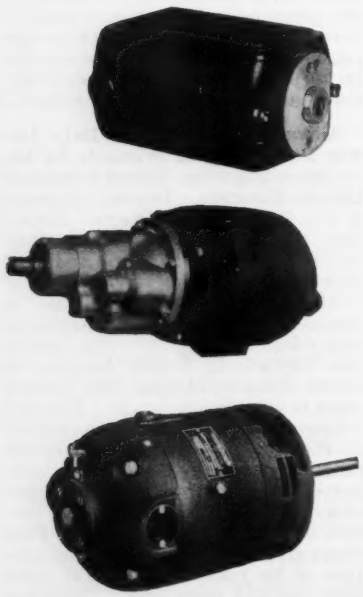

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and diagrams related to crankshaft design. The functions of an index are assumed by the detailed table of contents, and there is a page of bibliographic references to works in French.

La Technique des Radiateurs d'Aviation et de leur Carénage (Aviation Radiators and Their Fairing). Louis Breguet. Paris, Dunod, 1939. 78 pp. (Frs. 64.)

This work analyzes the physical conditions connected with the problem of regulation of the temperature of lubricants and coolants in order to minimize the temperature variation of moving parts in spite of variations of the outside air. Several chapters cover the questions of connection of a warm surface, warming of air in the radiator core, resistance of an unwarmed core, and coefficient of friction of the core. The subject of fairing is then introduced, and the following chapters deal with coefficient of flow, ponderal flow of air and the frontal surface of the core, internal overall resistance to cold of a faired core, efficiency of fairing, exposed core in the wind, and drag. The last chapters cover cooling, effect of warming of air on internal circulation, coefficient of airflow, resistance to warmth of a faired core, and optimum adaptation of the radiant core. The conclusions given are that only the resistance of liquid-cooled motors may be lowered in view of the refinement of airplane designs; even with special cooling liquid a core in the open absorbs 23 per cent of the engine's power at 600 km. an hour; a faired core can be cooled with 7 per cent of the engine power between 550 to 600 km. per hour; and a core in the fuselage will require 2.5 per cent of the engine power for cooling at 600 km. an hour. This is a continuation of a work published in *La Science Aerienne* of November-December, 1938.

Vitesses Critiques de Résonance dans les Arbres Moteurs (Critical Resonance Speeds in Engine Shafts). S. D. Wassutinsky. Paris, Dunod, 1941. 98 pp., diagrs. (Frs. 92.)

The aim of this work is to present essential questions on the problem of crankshaft resonance without going into purely theoretic considerations, so as to arrive quickly at practical solutions. Difficult differential equations have therefore been omitted and only those details of the problem that the reader will expect to use are included. The writing of equations has been simplified and damping has been left for a separate chapter. The subjects of chapters are: torque, natural frequencies of the shaft, physical constants of the crankshaft, influence of damping, and reduction of critical speeds.

The Art of Flight Instruction. Edwin C. Bailly, Jr. New York, Harper and Bros., 1947. 222 pp. $3.00.

The author has had much teaching experience and presents here material on teaching methods and procedures for the flight instructor. Beginning with some general principles and observations, the author then discusses the student-instructor relationship and the question of maintaining the student's desire to learn, "pushing" and "leading." Some aspects of teaching and learning, such as failure in informal teaching, supervised practice and interference with student, are followed by a consideration of approaches to learning, explanation and demonstration, and analyzing errors. A chapter on thought patterns includes such topics as visual clues, distractions, interference on dual controls, tracking down errors and automatic reflexes. The following seven chapters, under the general heading of "the curriculum" present, first, the framework set by the C.A.A., air work and maneuvers, and then a progressive analysis of teaching procedure for a student's first six flights. The concluding chapters are on practice of landings, progress to solo, and from solo to private pilot's test. A foreword is contributed by Wolfgang Langewiesche.

La Normalisation (Standardization). Jacques Maily. Paris, Dunod, 1946. 472 pp.

The introduction to this detailed study explains that the word "normalisation" is used instead of "standardization" because the latter is foreign in sound, and somewhat difficult to pronounce. Following a discussion of the historical, theoretic, and general introductory phases of the subject, including a list of the standardization organizations in 19 countries, the discussion is taken up in two broad divisions: general study of standardization, and standardization in France. There are supplementary sections on standardization in Germany and England, and international standardization.

The work of standardization is divided into simplification, unification, specifications, and test methods. Standards may involve terminology, measurement, dimensions, or quality. Three general principles are listed: standards should constitute a perfectly homogeneous whole; standardization should establish a state of equilibrium between the technical field and industrial possibilities; and rational and practical standards may be established only by the cooperation of all interests on an equal footing. The book ends with information on standardization during the war, its present organization and functioning in France, England, and Germany, and as applied internationally.

Other Books Received

AERODYNAMICS

Hydro- und Aeromechanik nach Vorlesungen von L. Prandtl. Erster Band, Gleichgewicht und Reibungslose Bewegung (Hydro- and Aeromechanics Based on Lectures of L. Prandtl. Vol. I, Equilibrium and Frictionless Motion). O. Tietjens. Vienna, Springer Verlag, 1944. 238 pp., illus. A new edition in German of a standard work which first appeared in 1929 and was later published in translation in the United States.

Ballistik (Balliatics). Richard E. Kutterer. (Die Wissenschaft, v. 97) (Braunschweig, 1942) Ann Arbor, Mich., Edwards Bros., Inc., 1946. 208 pp., illus. $5.00. Reprint in German of a standard work on the theory and practice of interior and exterior ballistics. Trajectory in a vacuum and in air-filled space is discussed, followed by problems of exterior ballistics, the mechanics of gases and applications to the problems of ballistics. The second part presents the elements of interior ballistics, methods of calculating various measurements, and special questions of the subject. Appendixes cover mathematical tables, formulas, and a short bibliography of important works. There are also name and subject indexes. There are many graphs and diagrams, and some photographs of moving projectiles.

AIR TRANSPORT

Transport Facilities, Services and Policies. Emory R. Johnson. New York, D. Appleton-Century Co., 1947. 409 pp. $3.50. The purpose of the author is to present an account of the facilities used and the services rendered by the several transportation agencies. The policies followed by the carriers and the Government concerning the development, interrelations, and the services of the five methods of transportation are discussed. The book is not intended to replace larger textbooks upon which the author collaborated. Railroad and electric railway transportation, inland waterways and ocean transport, highway transportation, air transportation, and pipe-line transportation are discussed, with a final chapter on problems and conclusions as to the public policy best calculated for their solution.

Annual Airline Statistics. Domestic Carriers, Calendar Year 1944. U.S. Civil Aeronautics Board, Economic Bureau, Accounting and Rates Division. Washington, D.C., Govt. Printing Office, 1946. 56 pp. Summary of commercial operations including revenue and expenses, mileages flown, traffic carried, utilization of aircraft, etc. Arrangement is frequently by individual routes, with totals for each carrier's system.

Transportation Principles and Problems. Truman C. Bigham. New York, McGraw-Hill Book Co., 1947. 626 pp., illus. $5.00. The first four chapters of this textbook on the economics of transportation deal with introductory subjects, including the effects of improved transportation, transport development, the nature of the transportation system, and transportation costs. State and federal legislation are next taken up, and the following seven chapters deal with rates. The final chapters cover service, issue of securities, combination, labor, public aid, Government ownership, and the general improvement of public policy. Air transportation is included in the discussion throughout. There are bibliographies at the ends of chapters and a correlated list of films.

AIRPLANES

Aerolog, the Directory of Plane, Engine, and Propeller Parts. 1947 Edition. Austin, Tex., The Steck Co., 1947. 145 pp., illus. Data are given for Aeronca, Bellanca, Engineering and Research, Fleet, Luscombe, Meyers, Piper and

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Republic light airplanes, and Ranger aircraft engines. The information varies from operating manuals or detailed parts lists for Bellanca, Ercoupe, Meyers, Piper, and Republic models, to brief specifications and lists of distributors.

Aircraft of the Fighting Powers. Vol. VII. O. G. Thetford and E. J. Riding. Ed. by D. A. Russell. Leicester, The Harborough Publishing Co., Ltd., 1946. 78 pp., illus. 31s., 6d. This is the last of seven volumes in the series, and the first to be produced under peacetime conditions, unhindered by censorship. It contains an index to the complete set. There are 18 entries for the United States including the Douglas XB-42 Mixmaster, the Lockheed P-80A Shooting Star, the Ryan FR-2 Fireball, and the Sikorsky HOS-1 Hoverfly II. Each entry consists of over half a page of text giving details, including purpose, construction, and history, as well as specifications for performance, dimensions, weight, areas, loadings, armament and power plant. The historical information is especially detailed and is a feature not always found in works of this type. Each historical entry occupies half or more of the space devoted to text. There is at least one photograph of each plane, and in some cases as many as five. Another feature of value, not always included in similar works, is the three-way 1/72-scale drawing for each plane. Most of these are on folding sheets.

Aircraft of the 1914–1918 War. Owen G. Thetford and E. J. Riding. Leicester, The Harborough Publishing Co., 1946. 126 pp., illus. 31s., 6d. Information on the aircraft of World War I heretofore scattered or available in selective works has been assembled in this reference work, compiled with great care and wide research. Each plane is represented by photographs, specifications, and history, and three-way 1/72-scale drawings. Figures quoted are those from official documents. An appendix illustrated with photographs covers over 100 experimental and rare aircraft types.

AIRPORTS

Municipal Airport Management. Leslie A. Bryan. (University of Illinois, Institute of Aeronautics, Aeronautics Bulletin No. 1.) Urbana, Ill., 1947. 26 pp. A concise statement by the Director of the University of Illinois Institute of Aeronautics of financial aid and sponsor procedure under the Federal Airport Act of 1946; the airport lease and contract provisions in municipal operation; forms of control, and the airport department structure and duties; qualifications and duties of the airport manager; sources of airport revenue, airport expense ratios, and airport accounting.

Colorado Aviation Development Survey. Report to Colorado Aeronautics Commission. Prepared by University of Colorado, Bureau of Business Research and Engineering Experiment Station. Boulder, Colo., 1946. 269 pp., illus. The existing economy of the state and the present situation in aviation is surveyed, to evolve a program designed to outline the most useful system of landing facilities for Colorado which can be currently anticipated.

Comprehensive Study Relating to Aeronautical Facilities for Metropolitan Area of Chicago, Projected to 1970. Vol. 1. Text. Prepared by the General Airport Co., Stamford, Conn. Springfield, Ill., Illinois Department of Aeronautics, 1946. 239 pp., illus. An engineering study arriving at future airport requirements for the Chicago area by considering aircraft design trends, airport location and design factors, including zoning, land use predictions, and population predictions. Scheduled traffic and the number of nonscheduled aircraft are predicted for the United States and for the Chicago area, with reference to passenger, freight, express and mail traffic and types of aircraft.

The 1947 National Airport Plan. Washington, Civil Aeronautics Administration, 1947. 103 pp. A summary of the National Airport Plan for 1947, including a list of 4,431 airports that the C.A.A. believes should be constructed or improved during the next 3 years.

The Origin, Distribution, and Airphoto Identification of United States Soils, with Special Reference to Airport and Highway Engineering. D. S. Jenkins, D. J. Belcher, L. E. Gregg, and K. B. Woods. (U.S. Civil Aeronautics Administration. Technical Development Report No. 52.) Washington, Govt. Printing Office, 1946. 202 pp., illus. $2.00. Information and techniques to assist the engineer in the mapping and evaluation of soils and for studying terrain characteristics of sites for specific engineering uses such as airports, roads, and the location of gravel pits and rock quarries. Figures and tables, and a bibliography of 772 references, are supplied in Appendix A.

Airphotos Illustrating the Origin, Distribution, and Airphoto Identification of United States Soils. (U.S. Civil Aeronautics Administration. Technical Development Report No. 52. Appendix B.) Washington, Govt. Printing Office, 1946. 63 pp. An appendix accompanying the above report.

Proceedings of 17th Annual Convention. American Association of Airport Executives. Chicago, May, 1946. 128 pp. Verbatim record of discussions and addresses concerning problems and future plans of airports. The addresses are informal and cover such aspects of airport management and operation as fees, taxation, finances, traffic, and public relations.

AVIATION INDUSTRY

The Buyers of Surplus Aircraft, A Market Study. Washington, War Assets Administration, Office of Information, 1947. 16 pp. An analysis of sales of surplus aircraft as of April 30, 1946. These are planes having utility for civil use and eligible for certification by the C.A.A.

Industrial Preparedness, Education in Aviation. A Record of the Air Power League's Aviation Forum held November 18, 1946, at the National Aircraft Show, Cleveland. New York, The Air Power League, 1946. 37 pp., illus. Short addresses and discussion. The speakers on industrial preparedness are Albert J. Weatherhead, Jr., Richard R. Deupree, J. Carlton Ward, Jr., Rear Adm. Thomas S. Combs, Lt. Gen. Nathan F. Twining, and Frederick C. Crawford. Those who spoke on education are Charles F. Kettering, Dr. William E. Wickenden, Dr. John H. Furhay, Rear Adm. Luis de Flores, and Brig. Gen. Thomas C. Darcy.

Minutes of the Council of the Office of Production Management. U.S. Civilian Production Administration. Bureau of Demobilization. (Historical Reports on War Administration. War Production Board. Documentary Publication No. 2.) Washington, Govt. Printing Office, 1946. 102 pp. $0.35. These minutes cover the period from December 21, 1940, to January 14, 1942. A detailed index provides a key to the aircraft and related portions of the discussions.

Minutes of the War Production Board. U.S. Civilian Production Administration. Bureau of Demobilization. (Historical Reports on War Administration. War Production Board. Documentary Publication No. 4.) Washington, Govt. Printing Office, 1946. 457 pp. $1.50. These minutes cover the period from January 20, 1942, to October 9, 1945. A detailed index provides a key to the aircraft and related parts of the discussions.

U.S. Military Aircraft Acceptances 1940–1945; Aircraft, Engine and Propeller Production. U.S. Civil Aeronautics Administration, Office of Aviation Information, Division of Aviation Statistics. Washington, 1946. 204 pp. These statistical tables include such separate sections as: airplanes by type, number and air-frame weight, manufacturer and model; engines by number and horsepower, manufacturer and model; employment, by individual plant. Civil transport planes of twelve places or more are included in the report.

BIOGRAPHY

Gustav de Laval, 1845–1913, de Höga Hastigheternas Man (Gustav de Laval, 1845–1913, the Man of High Speeds). Edited by Torsten Althin. Stockholm, A. B. de Lavals Ångeturbin, 1943. 352 pp., illus. Published on the fiftieth anniversary of the founding of the turbine manufacturing company bearing de Laval's name, this is a technological history as well as the biography of a great industrialist. While most of his work was concerned with steam turbines and dairy machinery, he found time for aeronautical experiments and conjectures. In 1900 and 1901 he was experimenting with a wooden and steel propeller having different blade profiles and in some cases laminated blades. Wind-tunnel tests were made on slotted wings as early as 1901. He sketched an idea for a rotating wing aircraft in 1908. Bibliographies of the writings of Gustaf de Laval, articles on his developments in steam turbines, dairy machinery, and electrometallurgy, and a list of his patents are included.

DRAFTING

Drafting for Electronics. L. F. B. Carini. New York, McGraw-Hill Book Co., 1946. 211 pp., illus. $2.50. Material not previously published is presented in this book. Following several chapters on such fundamentals as lettering, abbreviations and symbols, there are chapters on schematic delineation, circuit projection, patent drawing, and graphic integration as applied to circuit diagrams, and specific parts such as meters, resistors, capacitors, and coils. The concluding chapters cover the checking of drawings, and preparing prints and drawings for reproduction. There is an appendix of standards, an extensive list of visual aids, and an index.

ELECTRONICS

The Electronic Engineering Handbook. Edited by Ralph R. Batcher and William Moulic. New York, Electronic Development Associates, 1944. 456 pp. $4.50. The editors' purpose is to introduce electronic principles that can be applied to industrial problems and to other arts and sciences. A basic knowledge of electrical circuit principles is assumed. The first two-thirds of the book deals with vacuum tube and electronic circuit fundamentals. Applications of electronics to high-frequency heating and industrial sound are discussed, and the book ends with 26 pages of vacuum tube data and tables.

ENGINES

Éléments de Thermodynamique et Physio-Chimie de la Combustion dans les Moteurs (Elements of Thermodynamics and Physical Chemistry of Combustion in Motors). Max Serruys. Paris, Dunod, 1945. 106 pp., illus. Professor Serruys has combined the illustrations and text from a group of courses given in 1942–43 at the Centre d'Études Supérieures des Ingénieurs de l'Automobile. The introduction states that the work is a condensed treatment, without higher mathematics, of some of the more recent and more useful theories. Half of the book is devoted to efficiency, first in its theoretic application and, second, in respect to actual combustion conditions. Part of the latter section covers Diesel engines. The other two chapters are on spread of combustion in internal-combustion engines, and controlled combustion in injection engines. Most of the diagrams are performance curves and there are some cutaway drawings. A 2-page table lists the principal characteristics of fuels.

Flight Engineering. U.S. Navy Department, Bureau of Naval Personnel, Standards and Curriculum Division. Washington, Govt. Printing Office, 1946. 271 pp., illus. $0.50. The development of the flight engineer's job and its nature are followed by discussions of power and factors affecting it, specific fuel consumption, effects of altitude on power, power and fuel flow charts, power and carburetor air temperature, loading, and cruising control, including long-range cruising technique.

Symposium on Jet Propulsion, Gas Turbines, Rockets. New York, Society of Automotive Engineers, 1946. $8.00. ($4.00 to S.A.E. members.) Mimeographed or reprinted papers pre-

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sented before various meetings of the Society of Automotive Engineers between January, 1945, and July, 1946. The collection includes 30 papers.

Torquing of Nuts in Aircraft Engines. Progress Report No. 1. New York, Society of Automotive Engineers, May, 1946. 109 pp., diagrs. $4.00. Following a section of text there is a collection of graphs showing results of tests made by several firms. The conclusion is drawn that the only accurately known method of measuring nut tightness is by measuring bolt stretch. The text covers tightening, fatigue, stress, arrangement, and bending loads.

FUELS AND LUBRICANTS

A.S.T.M. Standards on Petroleum Products and Lubricants. Methods of Testing, Specifications, Definitions, Charts and Tables. Philadelphia, American Society for Testing Materials, 1946. 615 pp. $4.00. About 130 A.S.T.M. test methods, specifications, and definitions are included in this latest annual edition. New specifications covering aromatic hydrocarbons have been added, and revisions of numerous procedures, including the test for knock characteristics of aviation fuels. There is a detailed index.

Symposium on Oil Procurement Practices. Philadelphia, American Society for Testing Materials, 1946. 53 pp. $1.00. Current oil procurement practices are described by representatives of General Electric Company, Eastman Kodak Company, Pan American Airways, Inc., Ford Motor Company, and the U.S. Navy. A recommended practice for oil procurement by a representative of the Socony-Vacuum Oil Company is included. Details of some tests and specifications are given.

HISTORY

Heroes of the Air. Revised and enlarged by Martha Wood. New York, Thomas Y. Crowell Co., 1946. 484 pp., illus. $2.50. This is the first revision of Chelsea Fraser's original work since the war. It is a complete revision. As the publisher points out, some of the material of earlier editions was outmoded and continual additions had distorted its arrangement. About one-fourth of this new edition is devoted to flights of 1941–1945, including the first transatlantic ferry, the first raid on Tokyo by Doolittle, the first atomic bomb flight, and sections on the Flying Tigers, Midway, Ploesti, D-Day, and Flying the Hump. Earlier material has been revised and the entire book reset. The chronology has been brought up to January, 1946. The material has been selected for its historical significance rather than its news value, and an appropriate conclusion to such a careful job of revision should be an index or a detailed table of contents. Unfortunately, neither has been supplied.

HYDRAULICS

Hydraulic Measurements, a Manual for Engineers. Herbert Addison. 2nd Edition. New York, John Wiley & Sons, 1946. 327 pp. $5.00. This new edition of a book first published in 1940 is concerned with measurement of the flow of liquids in closed pipes and conduits and in open streams, under ordinary engineering conditions. The treatment has been kept as general as possible, so that it may be applied to industrial liquids, such as oils and spirits, in addition to water. The author is professor of hydraulics at the Fuad I University, Giza, Egypt.

MACHINE DESIGN

Machine Design. Louis J. Bradford and Paul B. Eaton. 5th edition. New York, John Wiley & Sons, 1947. 283 pp., illus. $3.25. This new edition of a textbook last revised in 1940 includes material on the fatigue of metals, the nature of friction and lubrication, and special precautions necessary in designing parts made from aluminum. The authors are on the faculties, respectively, of The Pennsylvania State College and Lafayette College.

MAINTENANCE

Flugzeugwartung. Teil II: Die Wartung des Flugwerks (Airplane Maintenance. Vol. II: Maintenance of Structures). Cl. Böhne. Berlin-Charlottenburg, C. J. E. Volckmann, Nachf. E. Wette, 1942. 84 pp., illus. The maintenance of the airplane under various conditions. Subjects covered are: take-off preparations, flight, inspection, general rules, and fuel and oil pipe-line diagrams for eight types of German planes.

MAPS

Construction of Map Projections. H. A. Hoffmeister. Bloomington, Ill., McKnight & McKnight, 1946. 41 pp., illus. $1.00. Designed to be used in a standard semester course in cartography, this book aims to present basic principles of map projections and to give training in map drafting to beginning students. All mathematics has been eliminated. The author is a professor of geography at the University of Colorado.

MATERIALS

Metallische Überzüge (Metallic Coatings). Willi Machu. 2nd edition. (Leipzig, Becker & Erler Kom.-Ges., 1943.) Ann Arbor, Mich., Edwards Brothers, Inc., 1945. 643 pp., illus. $15.50. An American reprint in German of a standard work. Under the general heading of metal cleaning and coating procedure there is presented material on corrosion, preparation of metallic objects for metal coating, manufacture of metal coatings by heat, mechanical, and electrochemical processes. Each type of metallic coating is discussed in detail in the second and larger section under the heading: Manufacture of Metallic Coatings, Their Characteristics and Testing Process.

The Production and Properties of Plastics. S. Leon Kaye. Scranton, Pa., International Textbook Co., 1947. 612 pp., illus. $5.00. Topics treated in this work include selection of raw materials, treatment processes, design of molds, application of heat and pressure, finishing operations and tests, and practical applications of finished materials. It is written on a technical level and is intended as a reference work for craftsmen as well as a text for senior high schools and colleges. Technical terms are explained and shop hints and procedures are included. The illustrations consist of photographs, diagrams, and charts. An extensive glossary, a selected bibliography, and a useful directory of trade names with type of product and manufacturer are included.

Resistance of Materials. Fred B. Seely. 3rd edition. New York, John Wiley & Sons, 1947. 486 pp., illus. $4.00. This new edition of a well-known textbook, last revised in 1935, includes developments on the use of light metals and plastics in load-resisting members of large strength-weight ratios, high-strength metals, welded connections, and the use of metals at extremely low temperatures, as at altitude, and extremely high temperatures, as in superchargers and gas turbines. The first part deals with the more elementary parts of the subject, and the second with special topics.

MATHEMATICS

A First Course in Mathematical Statistics. C. E. Weatherburn. Cambridge, at the University Press; New York, The Macmillan Co., 1946. 271 pp. $3.50. The aim of the author is to present the mathematical foundations of the interpretation of statistical data for the student with average mathematical equipment, including ordinary knowledge of the integral calculus. The treatment is based on a course of lectures given by the author at the University of Western Australia for several years, designed for students in the biological, social, and physical sciences. The properties of distributions, theory of sampling and tests of significance, and the theory of partial and multiple correlations are among the subjects covered. A feature is the use of beta and gamma functions in proving the sampling distributions of statistics, for the purpose of bringing simplicity and cohesion to the theory.

Analytical Geometry and Calculus. John F. Randolph and Marc Kac. New York, The Macmillan Co., 1946. 642 pp. $4.75. The calculus is introduced early in this book by focusing attention on graphs and their relations to equations, and by postponing the discussion of important but less fundamental subjects, such as conic sections, translation and rotation of axes, parametric equations, and polar coordinates. Analytic geometry and calculus are treated together with the aim of complementing each other. The formal presentation is made in a larger size of type, with two groups of problems, one for formal study and one for additional practice and review. A third group of problems accompanies the parts of the text printed in smaller type for students wishing to go further. The authors are members of the faculties of Oberlin College and Cornell University, respectively.

Aufgaben und Lehrsätze aus der Analysis (Problems and Theorems in Analysis). G. Polya and G. Szego. (Berlin, 1925.) New York, Dover Publications, 1945. 2 Vols. 342, 412 pp. $3.50 each. Reprint in German of a work in which development of technique is secondary to cultivation by the reader of good habits in mathematical thinking. There is an English translation of the table of contents and a German-English glossary. Volume 1: Series, Integral Calculus, Theory of Functions; Volume 2: Theory of Functions, Zeros of Polynomials, Determinants, Number Theory.

Descriptive Geometry. Earle F. Watts and John T. Rule. New York, Prentice-Hall, Inc., 1946. 301 pp., diagrs. $3.00. The authors are professors of drawing and descriptive geometry at the Massachusetts Institute of Technology. This work is intended to cover the basic material of elementary graphical theory applicable to engineering problems, and various methods of attack on problems are pointed out instead of just one method. Chapters have been added in the appendixes covering "Precision in Drawing," the "Properties of Plane Figures," and "Stereoscopic Drawing." Other subjects are "On the Systematic Solution of Problems," "Graphical Computation," "Analytic Solutions," and "Practical Applications." There are review figures with exceptionally clear captions at the end of many chapters.

Introduction to Mathematical Statistics. Paul G. Hoel. New York, John Wiley & Sons, 1947. 258 pp. $3.50. This textbook is designed for students who have studied elementary calculus, and for statisticians requiring a modern reference book on the fundamental methods of mathematical statistics. Frequency distribution and theoretic frequency distribution of one, two, and more than two variables, sampling inspection, design of experiments, and the testing of statistical hypotheses are among the subjects discussed.

Subtropical Flow Patterns in Summer. Herbert Riehl. (Department of Meteorology of the University of Chicago. Miscellaneous Report Number 22.) Chicago, The University of Chicago Press, 1947. 64 pp., illus. $1.25. This report resulted from the desire of the U.S. Weather Bureau for further studies of thunderstorm situations in summer along the Gulf Coast. The basis of the study is a detailed analysis of the upper air, especially of the changes that result from the interaction between the two major zonal currents.

The Theory of Functions of Real Variables. Lawrence M. Graves. New York, McGraw-Hill Book Co., 1946. 300 pp., diagrs. $4.00. The book includes the more fundamental and generally useful parts of the theory and many results not generally found in standard treatises, such as theorems on implicit functions, differential equations, and the Lebesgue and Stieltjes integrals. For the benefit of beginning graduate students an entirely abstract approach has been avoided, but certain chapters guide the reader toward the abstract point of view. Chapter I presents some fundamental concepts of logic.

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At the end of each chapter there are references. The author is a professor of mathematics at the University of Chicago.

Vorlesungen über Differential Geometrie und Geometrische Grundlagen von Einsteins Relativitätstheorie (Lectures on Differential Geometry and Foundation of Einstein's Theory of Relativity). Wilhelm Blaschke. (Berlin, 1924.) New York, Dover Publications, 1945. 311 pp., diagrs. $3.50. Reprint in German of the third revised edition, with an English translation of the table of contents and a German-English index-glossary. This work served also as an introduction to original research in the field. There are lists of problems and theorems at the ends of chapters.

MEDICINE

Management of Allergic Diseases. U.S. Army Air Forces. (Manual 25-0-4.) Washington, Govt. Printing Office, 1946. 53 pp. $0.20. The diagnosis, treatment, prognosis, and disposition of allergic diseases occurring in A.A.F. personnel.

METEOROLOGY

Algumas Notas Sobre a Visibilidade em Coimbra (Some Notes on Visibility at Coimbra). Vitorino de Seica e Santos. Coimbra (Portugal), 1943. 32 pp., tables. Conclusions drawn from observations made for several years at the Geophysical Institute of the University of Coimbra. There are 16 pages of discussion followed by 13 tables of observations of horizontal visibility by months since 1930 and other miscellaneous summaries.

O Estudo da Alta Atmosfera e as Radio-Sondas (Study of the Upper Atmosphere and Radiosondes). Alberto Barata Pereira. Coimbra (Portugal), 1943. 19 pp., 1 pl. Some history of upper atmosphere soundings until the appearance of radiosondes, with descriptions of 13 most frequently used radiosondes and results obtained with them, descriptions of two radiosondes of German type which fell near Coimbra. The paper was originally presented in 1942 at the Congresso Luso-Espanhol para o Progresso das Ciencias.

Bibliographie Météorologique Internationale (Nouvelle Série) Tome V, Année 1937 (International Bibliography of Meteorology. (New Series)). Vol. 5, 1937. Office National Météorologique et Société Météorologique de France. Paris, 1946. 449 pp. Books and periodicals in several languages are indexed and the entries arranged according to a decimal classification. A key to the classification and an index of authors are given.

A Case Study of Icings in the Alaskan-Aleutian Area. (Oct. '43–Apr. '44). U.S. Army Air Forces, Weather Central, Alaska. Middletown, Ohio, Air Technical Service Command. 309 pp. Synoptic maps and upper air soundings on 291 opposite pages for areas where icing occurred are preceded by a summary and discussion of findings. The information was collected by pilots of the 42nd and 54th Troop Carrier Squadrons.

A Study of Interdiurnal Pressure and Temperature Variations in the Free Atmosphere over North America. Thomas F. Malone. (Papers in Physical Oceanography and Meteorology published by Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, Vol. IX, No. 4.) Cambridge and Woods Hole, Mass., 1946. 50 pp., folding diagrs. $0.75. Aimed at utilising and extending the information recently available as a result of the network of radiosonde observation stations, and particularly to investigate the geographic and seasonal differences in the mean values of pressure and temperature variations at all levels and the related upper air conditions.

MODELS

Construction et Vol des Modèles Réduits; Guide Pratique pour la Jeunesse (Construction and Flying of Models. Practical Guide for Youth). W. Dollfus and A. Degen. Zurich, Aero-Verlag, 1943. 144 pp., illus. This book was produced at the request and with the help of the Swiss Pro Aero foundation, and was written by two specialists in models of the Aero Club of Switzerland. Intended not only for young people but also for educators whose responsibility it is to train the youth in premilitary aeronautics, it therefore stresses the scientific and technical aspects of flight and construction.

Design for Flight; Fundamentals of Aviation Demonstrated by Building and Flying Models. Charles H. Grant. New York, Greenberg, 1947. 275 pp., illus. $3.95. A general introduction is followed by chapters on planes classified according to performance, arrangement, and structure, as well as on the building and flying of each type of model. Gas-engine models are included and emphasis is on construction techniques, tools and materials, parts and proportions, stability, launching and flying, and comparative performances.

Model Diesels. Compiled by D. J. Laidlaw-Dickson, edited by D. A. Russell. Leicester, The Harborough Pub. Co., Ltd., 1947. 128 pp. 7*s*., 6*d*. The field of model Diesels, which has been developed intensively in Europe, is covered in this valuable work which was compiled from information given by makers of the models together with data resulting from 4 years of experiments by the Aeromodeller Research Staff. The design and operation of some 50 engines from European countries are given in detail. Building instructions are presented for a 5 c.c. engine with advice on materials and shop method. The concluding chapters on timing devices, specific Diesel-powered models, and further uses, are followed by an appendix giving characteristics of leading Diesel engines, fuel mixtures, and a list of manufacturers.

NAVIGATION

The American Air Almanac. January-April, 1947. U.S. Naval Observatory. Washington Govt. Printing Office, 1947. 240 pp. $1.00.

PERFORMANCE

Aeroplane Performance Theory for Pilots and Flight Engineers. E. Davison. London, Sir Isaac Pitman & Sons, 1946. 138 pp., diagrs. 8*s*., 6*d*. The author's purpose is to present the basic principles of flight and of the theory of engine handling for air crews. Emphasis is placed on factors affecting aircraft and engine handling. Mathematics has been kept to a minimum in the treatment, and the mechanical principles involved have been explained with accompanying exercises to give practice in their application. The properties of the atmosphere, measurement of air speed, the wings, the complete airplane, work and power, engine operating conditions and variations with altitude, the propeller, fuel and loading calculations, level flight, and climbing are among the subjects discussed. This book fills a need for more good manuals on the performance theory of heavy aircraft and should prove useful.

PHYSICS

Cosmic Radiation; Fifteen Lectures, edited by W. Heisenberg. Translated by T. H. Johnson. New York, Dover Publications, 1946. 192 pp., illus. $3.50. The lectures making up the volume were given in 1941–1942 in the Kaiser Wilhelm-Institut for Physics and are intended to give a picture of knowledge of cosmic radiation at the end of 1941. The foreword states that the investigations of Malière on the large showers, the calculations of Flügge on the neutron distribution in the atmosphere, and a simplified cascade theory from lectures given by the editor in the United States in 1939, are results that were not published elsewhere. The divisions of the volume are: Introduction, by Heisenberg; Cascades, with two articles by Heisenberg and Malière; Mesons, with articles by Wirtz, Klemm, Heisenberg, Voltz, Weizsäcker, Bopp, and Flügge; Nuclear Particles, by Bagge and Flügge; and Geomagnetic Effects by Meixner. There is an index and a 6-page list of references. The original German edition was prepared as a dedication to Arnold Sommerfeld and after only a few copies were distributed the stock of plates and volumes was destroyed by bombs. This translation was made from one of the few copies to reach the United States.

Praktische Physik; zum Gebrauch für Unterricht Forschung und Technik (Practical Physics for Use in Instruction, Research, and Technology). F. Kohlrausch. 17th edition, revised. (Leipzig, 1935.) New York, Mary S. Rosenberg, 1944. 958 pp., diagrs. $8.75. A reprint in German of the 17th German edition that was revised by a staff of 19 specialists. The work is intended to be useful to industry as well as to students. Section headings are: Measurement; Mechanics; Measurement of Properties of Matter (Temperature, Pressure, Density, Specific Gravity); Heat; Optics; Electricity and Magnetism; Particles and Energy Quanta.

PRODUCTION METHODS

Introduction to Production Control. D. Tiranti, with the collaboration of W. F. Walker. London, Chapman & Hall, 1946. Diagrs. 15*s*. The aim of this book is to explain briefly the production-control aspect of manufacturing. The author states that the importance of this is well established in the United States but has received less attention in England. Following introductory chapters on the purpose of production control and its relation to factory organization, the book takes up written standard practice, forms, charting, the production plan, scheduling, shop-loading, batch production control, manufacturing order control, progress or movement of work, stock control, and unit nomenclature. A useful bibliography and an index are included. The chapters on stock control and progressing, or movement of work, are by Mr. Walker. The chapters on the production plan, manufacturing order control, and shop-loading are offered as material covering new ground. Much of the material originated as articles in *Aircraft Engineering* and other periodicals, written by the author as Chief of Production Statistics of General Aircraft, Ltd.

Bibliography on High Frequency and Dielectric Induction Heating, compiled by the staff of Northwestern Technological Institute Library. Evanston, Ill., August, 1946. 97 pp. $0.15. Over 800 references, most of them annotated, are listed under theory and background, methods and techniques of heating, description and operation of furnaces, equipment, metallurgy, applications, and prospects.

PROPELLERS

Aircraft Propeller Airworthiness. U.S. Civil Aeronautics Administration. (Civil Aeronautics Manual 14.) Washington, Govt. Printing Office, 1946. 23 pp. $0.15. Minimum standards for establishing airworthiness ratings for propellers for use in aircraft.

RADAR

Radar Set AN/MPG–1 and Radar Set AN/FPG–1. Technical Operation Manual. General Description, Operating Instructions, and Equipment Performance Log. U.S. War Department. Technical Manual 11-1366. Washington, Govt. Printing Office, 1946. 116 pp., illus. $0.40.

REFERENCE BOOKS

Concise Chemical and Technical Dictionary. Edited by H. Bennett. Brooklyn, N.Y., Chemical Publishing Co., 1947. 1,055 pp. $10. About 50,000 terms are defined in this new dictionary. The interpretation of chemistry is broad, and terms from many related fields in the biologic and physical sciences and engineering are included, as are abbreviations and a large number of trade names. The formula, molecular weight, specific gravity, melting and boiling points, solubility in water and alcohol, and frequently the uses are given for chemical compounds and materials. Appendixes include lists of mathematical symbols, apothecary symbols,

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conversion tables for temperature and other measurements, a list of indicators, important organic ring systems, and a list of about 800 additional recent terms. This is a comprehensive dictionary, with good definitions, covering related fields sufficiently to be useful as a supplementary dictionary of engineering materials.

Classified List of Bibliographies in the Science Library Bibliography Series. London, Science Museum Library, November, 1946. 37 pp. The titles of bibliographies are arranged in subject order according to the Universal Decimal Classification, under about 60 main headings. The date of publication and the number of references in each bibliography are included. About 600 titles are listed.

The Aeronautical Dictionary. Thomas A. Dickinson. New York, Pitman Publishing Corp., 1945. 484 pp. $3.50. This excellent dictionary is again available after being out of print for several months.

Aeronautical Research Council. (Government Publications. Sectional List No. 8.) Revised to March 31, 1946. New York, British Information Services, 1946. 79 pp. A classified list of the British *Reports and Memoranda* (*R. & M.'s*), which are available for sale, with prices.

The Electronic Engineering Master Index, a Subject Index to Electronic Engineering Periodicals, January, 1935 to June, 1945. Edited by Frank A. Petraglia. New York, The Macmillan Co., 1946. 209 pp. $6.00. A reissue of Part II of the compilation issued in 1946 under the same title. About 10,000 articles from approximately 50 journals are indexed by subjects.

Ulrich's Periodicals Directory, a Classified Guide to a Selected List of Current Periodicals, Foreign and Domestic. 5th Edition. Edited by Carolyn F. Ulrich. Including a list of clandestine periodicals of World War II, by Adrienne Florence Muzzy. New York, R. R. Bowker Co., 1947. 399 pp. $15. Includes about 125 aeronautical periodicals.

RESEARCH

War Department Research and Development Program, Fiscal Year 1948. Prepared under the supervision of The Plans and Policy Office, Research and Development Division, War Department General Staff. Washington, 1947. 79 pp. Major Gen. H. S. Aurand states in his introduction that every effort has been made in this compilation to give as true a picture of the research and development activities of the War Department as is consistent with national security. The general policies and the general procedure are stated in detail, then the programs of research of the Army (Technical Services) and for Air (Engineering Division, Air Matériel Command), are taken up. The Army program is described in 19 sections, including free rockets and launchers, communications, meteorology, radar, and atomic energy and fission products. The air program is described in 13 sections, including photography, aero medical research, armament, aircraft equipment, materials, power plants, aircraft projects, structures, climatic projects, electronics, guided missiles, personal equipment, and propellers and rotors.

Directory of Research and Development Facilities at Educational Institutions in New York State, Available to Industrial Concerns. Albany, New York State Dept. of Commerce, 1946. 79 pp. Research facilities in 58 fields of engineering and science in 26 colleges and universities are described. The names of key personnel, fields of specialization, and unusual equipment for research and development are included. A summary chart cross-indexes colleges and research fields.

ROCKETS

Rockets and Space Travel; the Future of Flight Beyond the Stratosphere. Willy Ley. New York, The Viking Press, 1947. 374 pp., illus. $3.75. A revised and enlarged edition of the book originally entitled *Rockets*. Two new chapters are included: The Rockets of the Second World War, which discusses the Nebelwerfer, the Bazooka, and other rockets and guided missiles; and Peenemünde! which covers the development of the V-1 and V-2 rockets, and contains an account of the activities of Wernher von Braun. There are also changes and additions in the passages concerning Professor Goddard, and a list of his patents is included in the appendix. There are many new headings in the appendix, namely: Notes on Rocket Motor Efficiency; Rocket Mail, Altitudes Attained by Radiosondes, Penetration Bombs; U.S. Rocket Ordnance; Second World War; Details of V-2; Mass-Ratio of Step Rockets; The Problem of Synergy; and Distribution of Meteorites in the Zodiacal Light. There is also a new 16-page appendix on rocket airplanes and rocket-assisted take-off. Several books have been added to the bibliography.

SCHOOLS

Airman Agency Certificates. Ground and Flying School Ratings. U.S. Civil Aeronautics Administration. (Civil Aeronautics Manual 50.) Washington, Govt. Printing Office, 1946. 20 pp. $0.15. Minimum facilities, equipment, personnel, and curricula required of a civilian aviation school to be eligible for certificate and rating as an air agency.

STRUCTURES

Bauelemente des Flugzeuges (Structural Elements of Airplanes). Herbert Wagner and Gotthold Kimm. Munich, R. Oldenburg, 1942. 295 pp., illus. Dr. Wagner's lectures are edited here with a foreword in which he states that those principles of structures are selected which apply to the consideration of general strength and force curves as well as the demonstration of special calculation methods for the usual structural characteristics of airplanes. The consideration of materials is planned to be taken up in a later work. The statics of simple frames, bending, torsion, bending combined with torsion, buckling, and buckling combined with bending are discussed.

Strength of Metal Aircraft Elements. U.S. Army-Navy-Civil Committee on Aircraft Design Criteria. (ANC-5, Amendment 2.) Washington, August, 1946. Revision pages for ANC-5, formerly entitled *Strength of Aircraft Elements*, December, 1942, include changes in chapter 1, "General," and chapters 4, "Steel," 5, "Aluminum Alloys," 6, "Magnesium Alloys," and 7, "Miscellaneous Metals." Chapter 2 is deleted since ANC-18, 19, and 21 supersede the material on wood. Chapter 3, "Metals—General," is deleted and pertinent material incorporated elsewhere in the text. The bibliography of 46 references has been revised.

Mechanics of Materials. Philip Gustave Laurson and William Junkin Cox. 2nd edition. New York, John Wiley & Sons, 1947. 422 pp., illus. $4.00. In this new edition of a textbook first published in 1938, a chapter on columns with axial loads replaces the former one on column theory, and a chapter on columns with eccentric loads replaces the one on design of columns. Mohr's Circle is added to the discussion of combined stresses. There are 640 problems. The tables appended to the book are sufficient for the solution of all problems in the text. Professor Laurson is on the faculty of Yale University and Mr. Cox is Commissioner of Highways, State of Connecticut.

TURRETS

Aircraft Turrets. U.S. Navy Department. Bureau of Naval Personnel. Standards and Curriculum Division. Washington, Govt. Printing Office, 1946. 240 pp., illus. $0.45. The various types of aircraft turrets and their applications are described, with an explanation of electric turret systems and analyses of individual hydraulic turrets. Trouble-shooting procedure, and turret bore-sighting are covered in the final chapters.

WORLD WAR II

Landing Operations, Strategy, Psychology, Tactics, Politics, from Antiquity to 1945. Alfred Vagts. Harrisburg, Pa., Military Service Publishing Co., 1946. 831 pp. $5.00. An exhaustive treatment of landing operations, including air-borne landings, which appeared on the scene in World War II. The Russians are given credit for the inception of parachute troop maneuvers, which were used by the Germans at Dunkerque and with greater success in Crete, and along with troop transports and gliders by the Allies in Sicily, Italy, and Normandy. The full story of air-borne operations in World War II may have to be told in more specialized histories, but Dr. Vagts has made an authoritative and useful beginning in this monumental work.

American Sea Power Since 1775. Members of the Department of English, History and Government, United States Naval Academy. Edited by Allan Westcott. Philadelphia, J. B. Lippincott Co., 1947. 609 pp., illus. $5.00. This is primarily an operational history of the U.S. Navy, covering its work in peace and war from the beginnings. More than half of the book is devoted to the period from 1914 to date, and the greater part of that to World War II. This proportion and perspective is consciously made and is partly caused by emphasis on technological advances and the influence of new weapons on tactical and strategical concepts. The treatment also stresses the variety of factors entering into sea power, such as bases and the supply of strategic materials. The close and increasing interdependence of sea, land, and air arms is also emphasized. The role of aeronautics in naval operations takes its place in the narrative, including brief mention of the contribution of the Naval Air Transport Service. A list of useful books is included and an index.

Brief Glory; the Story of the A. T. A. E. C. Cheesman. Leicester, Harborough Publishing Co., Ltd., 1946. 248 pp., illus. The story of the Air Transport Auxiliary, whose civilian pilots ferried planes for Great Britain during the war, is told with humor and authority by one of its pilots. The A.T.A. took its pilots from all walks of life, some of them veterans of the first World War and some girls in their early twenties. It contributed greatly to the success of the R.A.F. and its deeds might be forgotten unless brought together and presented in an account such as this. The work is well written and freely illustrated with photographs of individuals, places, and incidents. Listed in the appendix are rosters and information on ferrying figures, honors and commendations, pilots, and types of aircraft.

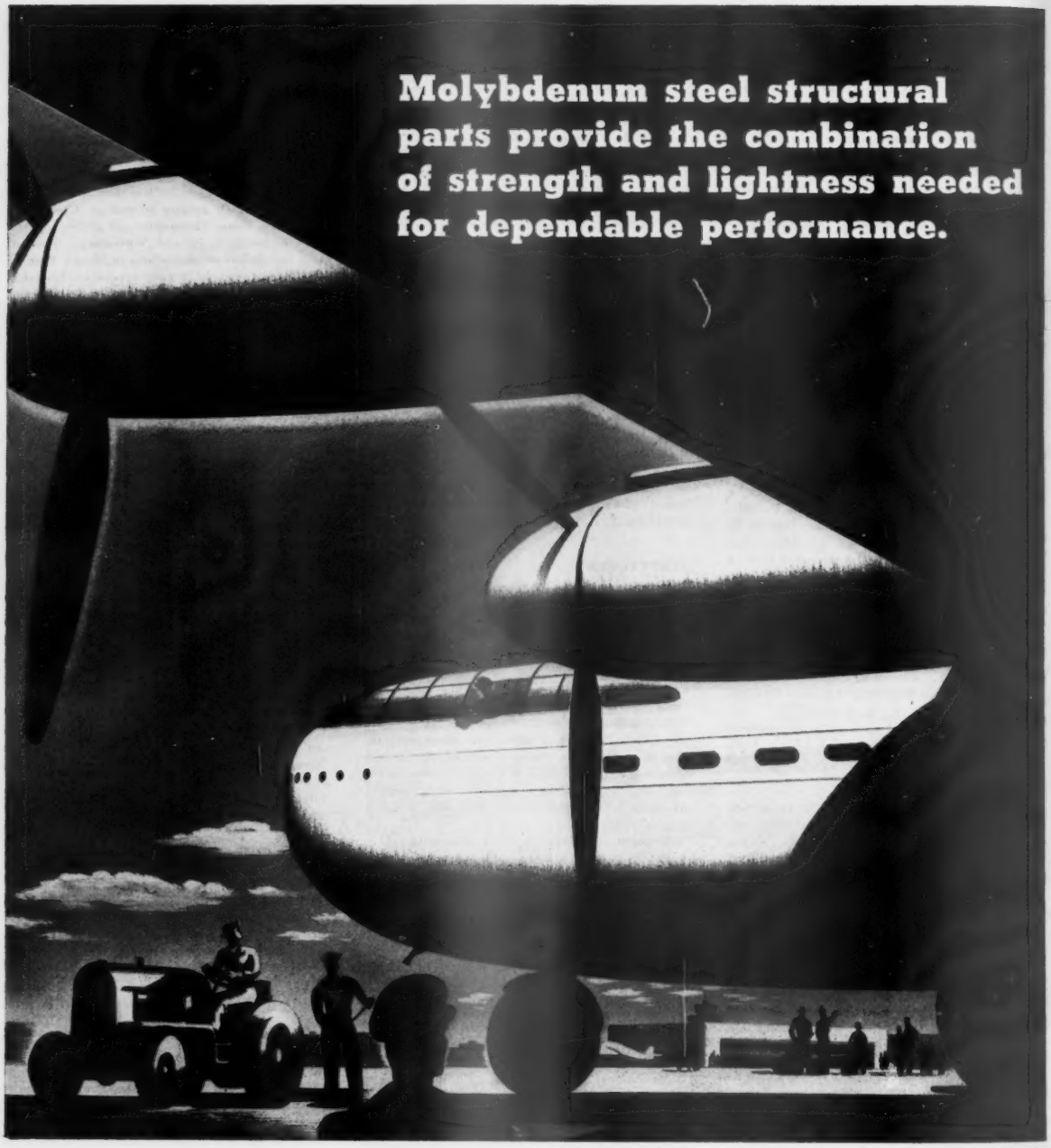
The United States Strategic Bombing Survey (Pacific). The Allied Campaign Against Rabaul. Naval Analysis Division. Marshall-Gilberts-New Britain Party. Washington, Govt. Printing Office, 1946. 273 pp., illus. $0.70. The five divisions of the party were concerned with military and naval studies, physical damage, transportation, area studies, and morale. The overall purpose was to study the progressive development of the Allied strategic plan as it affected these targets. The findings are presented in narrative style first, with supporting evidence in the annexes which form the bulk of the report.

The United States Strategic Bombing Survey (Pacific). Washington, Govt. Printing Office, 1946. The following parts have been received: **Japanese Motor Vehicle Industry.** 16 pp. $0.20; **Ishikawajima Aircraft Industries Company, Ltd.** (Corporation Report No. XIII. Engines). 23 pp. $0.15; **Nissan Automobile Company** (Corporation Report No. XVIII. Engines). 4 pp. $0.20.

Front-Line Airline; Air Transport During the South-West Pacific War 1939–44. E. Bennett-Bremmer. London, Paul Elek, Ltd., 1945. 80 pp., illus. 5*s.*, 6*d.* Based on official documents and aircraft logs of Australia's Quantas Airways.

Hommages des Ingénieurs Français au Major General C. R. Moore. Paris, 1945. 23 pp. Dedicated to the Commander in Chief of the Corps of Engineers of the European Theatre of

(*Continued on page 87*)



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Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Research Engineers and Physicists—Engineers, physicists, chemists, and mathematicians with research experience in problems related to aeronautics are needed by the National Advisory Committee for Aeronautics. Salaries for various positions requiring research experience range from $3,397 to $9,975 per year, depending on the type and level of work. Entrance positions for college graduates pay $2,644 per year. Areas of research include the following: aerodynamics, hydrodynamics, structures, materials, thermodynamics, compression and turbines, fuels and combustion, lubrication, mathematics, optics, electronics, radar, telemetering, servomechanisms, and other fields. Applications for positions or requests for further information should be addressed to the personnel officer at one of the following laboratories: Langley Memorial Aeronautical Laboratory, Hampton, Va.; Ames Aeronautical Laboratory, Moffett Field, Calif.; Aircraft Engine Research Laboratory, Cleveland.

Aircraft Equipment and Accessory Engineer—Excellent opportunity for graduate A.E., M.E. or E.E. with at least 4 year's practical experience as application engineer on electromechanical actuators, electric motors, and automatic control for aircraft. Reply to Lear, Incorporated, 110 Ionia Ave., N.W., Grand Rapids 2, Mich.

Electronic Engineer-Pilot—A position is open for a highly qualified electronic engineer who is also an expert multiengined pilot. The work will consist primarily of flight research and test of aeronautical automatic controls of many descriptions. The engineer will be involved from the inception of an idea or device, through its development stages, in the planning and flying of the tests, to the final demonstration and sales stages. It is desirable that the applicant be skilled in instrument and airways procedures or is a former air-line, N.A.T.S., or A.T.C. pilot. Apply by letter, giving engineering and flight experience and starting salary expected, to Chief Flight Test Engineer, Minneapolis-Honeywell Regulator Company, 2753 Fourth Ave. S., Minneapolis.

Engineers—Young engineering graduates with up to 3 years' experience required for test activity and aerodynamic or thermodynamic analysis on extensive and continuing development programs on nonrotating aircraft power plants. Mechanical or aeronautical engineers preferred. Address reply to Continental Aviation and Engineering Corporation, Detroit 14.

Aerodynamicists—College graduates with sound theoretical training and at least 1 year of graduate study in compressible subsonic flow and supersonic flow to do research and test work in the Supersonic Wind Tunnel of the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. This is one of the few operating supersonic wind tunnels in the country having a test section larger than 1 sq.ft. Remuneration in accordance with qualifications. Write, giving education and experience, to The Commanding General, Aberdeen Proving Ground, Md., Attention: Director, Ballistic Research Laboratories.

Aerodynamicists, Flight Test Engineers, Mechanical Engineers, Electronics Engineers, Physicist-Mathematician, Administrative Engineer—Competent to assume additional responsibility in an expanding engineering organization as staff and project engineers on new, diversified, challenging work in the development of complex aviation devices. Only those applicants possessing initiative and ability to think analytically are desired. Plant is located approximately 200 miles west of New York City. Wages paid are equal to, or above, locality average. For further details write to: Personnel Manager, Link Aviation Devices, Inc., Binghamton, N.Y.

Structural Designers—Experienced in sheet-metal aircraft structures for new helicopter design. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Layout Draftsmen—Five or more years' experience on aircraft layout and design. Rotary wing preferred. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Aerodynamicist and Vibration Specialist—Experienced in rotary wing field. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Assistant Designer—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must be capable of taking full responsibility for undercarriage design projects, and should have had some experience in design of hydraulic pumps, systems, and electro-hydraulic units. Knowledge of stress analysis and familiarity with both British and American engineering practices also desirable. This is a permanent position with good prospects. Starting salary $275 to $300 per month, depending on qualifications. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Senior Draftsman—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must have minimum of 3 years' experience in the more mechanical side of aircraft design work and, preferably, 1 year's design experience on undercarriage and hydraulics, variable-pitch propellers, fuel systems, or other similar accessories. Should be capable of detailing any undercarriage or hydraulic layout and of carrying out elementary stress analysis. Familiarity with both British and American engineering practices also desirable. This is a permanent position with attractive prospects. Starting salary proportional to qualifications offered. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Assistant or Associate Professor—To teach courses in aerodynamics and wind-tunnel and airplane design. Must have graduate work in aerodynamics. Prefer man with teaching and practical experience. Salary and position will depend upon qualifications. Applicants should submit detailed record of education and experience. Address reply to Aeronautical Engineering Department, University of Kansas, Lawrence, Kan.

Aerodynamicists and Aeronautical Engineers—Positions available for highly qualified technical personnel with good theoretical or experimental background to engage in development and test work in stability, control, high-speed, and supersonic aerodynamics. Projects include new designs of piloted and pilotless aircraft, new wind tunnels and associated equipment, and advanced testing techniques. Salary in accordance with qualifications and Civil Service regulations. In reply please give brief summary of personal qualifications, education and experience. Address: Director, David Taylor Model Basin, Washington 7, D.C.

Layout Draftsmen—College graduates preferred, with aeronautical or mechanical engineering degrees. Must have 3 to 5 years' experience in aircraft industry as layout draftsmen working on structures, stress analysis, and design. Plant located just outside Washington, D.C. Address inquiries to Engineering and Research Corporation, Riverdale, Md.

Engineers and Physicists—The Cleveland Laboratory of the National Advisory Committee for Aeronautics has openings for engineers and physicists to work in fundamental research applicable to aircraft propulsive systems. Research is in progress on engine performance, fuels, thermodynamics, compressors, turbines, and materials. Applications of the principles of fluid mechanics are being investigated in the speed ranges covered by subsonic, transonic, and supersonic flow rates. There are openings for professional men ranging from a starting rate of $2,644.80 per annum for men just out of college to $8,179.50 per annum for men with qualifying experience in their respective fields. Apply to National Advisory Committee for Aeronautics, Cleveland Airport, Cleveland, Ohio; Attention, Mr. John D. Tousignant.

Chief Aerodynamicist—Services of highly qualified aerodynamicist required to act as Chief Aerodynamicist. Applicants must be graduate engineers from recognized universities. Experience on personal aircraft desirable. Applicants should write, giving complete details of education, experience, and salary expected, as well as availability, to Fleet Manufacturing and Aircraft Limited, Fort Erie, Ontario, Canada.

Aerodynamicists—One or two positions open for experimental and theoretical research in supersonic aerodynamics in Navy Ordnance development program. Preference given to applicants with experience in supersonic field but will consider those with good background of fundamentals and subsonic work who wish to acquire experience in supersonics. Salary dependent on education and experience. Address: Dr. M. J. Thompson, Associate Director, Defense Research Laboratory, The University of Texas, Austin 12 Tex.

Physicist or Research Engineer—To do basic research and development work in applied optics related to supersonic airflow visualization. Work includes application of spark and schlieren photography and interferometry to supersonic wind tunnel test program. Salary dependent on education and experience. Address: Dr. M. J. Thompson, Associate Director, Defense Research Laboratory, The University of Texas, Austin 12, Tex.

Research Engineer—Responsible position open with small corporation engaged in development engineering on aircraft instrumentation and control systems. Background of mechanical engineering or applied physics required. Address inquiries to Flight Research Engineering Corp., P.O. Box 1-F, Richmond, Va.

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The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

706. Assistant Professor—To teach courses in aircraft structures and aircraft structures laboratory at an Eastern university. The primary duties of the position will be concerned with aircraft structures, but the applicant should possess enough knowledge of aerodynamics to permit him to assist occasionally in elementary aerodynamic courses. Prefer a man with teaching and practical experience. In applying, please give brief sketch of personal qualifications, education, and experience.

679. Professor of Aeronautical Engineering—To take charge of work in established department of aeronautical engineering at a large engineering college. A man with graduate degree, teaching and industrial experience preferred. Rank and salary dependent upon educational background and experience.

671. Instructor or Assistant Professor—Sought by Aeronautical Engineering Department of Southwestern university. Should have master's degree and be able to teach in fields of aerodynamics and fluid mechanics, structures, and power plants and be capable of specializing in one of these.

670. Research and Aerodynamics Engineers—Long-term helicopter development program for Army Air Forces requires additional experienced and capable engineers. Exceptional working conditions and opportunities. Work involves aerodynamics, vibration, and flutter analyses on advanced designs. Substantial experience in aerodynamics or vibration work essential. East Coast company.

651. Aeronautical Administrative Engineer—Experienced in handling Navy Contract procedures and in designing for production. All replies will be held confidential. East Coast company.

643. Professor of Aeronautical Engineering—To take charge of this work in a well-established department where specialization is largely in aircraft propulsion and aerodynamics. Large graduate enrollment, good industrial contacts, and opportunities for consulting and research work. Salary attractive.

634. Chief Engineer—Leading aircraft accessory firm making mechanical devices for aircraft. Located in a desirable Midwest city. Excellent opportunity for the proper man. Should be experienced in machine design, electrical design, small mechanisms, and possibly small rotating machinery. Must be experienced in handling people, supervising design, making engineering decisions for production, and supervising large number of projects. Please send complete information in first letter on entire background, including salary requirements and recent salaries. Our employees know of this opening and therefore applicants will not be embarrassed by writing to their own employer.

629. Assistant Professor—To conduct classes in airplane detail design and stress analysis in large engineering college. Must have aeronautical engineering degree and industrial experience. Advanced degree preferred but not essential. Immediate appointment. In replying, please submit brief record of education and experience.

627. Aeronautical Engineer—Civil Service position open immediately in Washington, D.C., for aircraft engineer with several years of progressive experience in structural design. Good opportunity for permanent appointment for engineer having proper qualifications. Duties involve responsibility for accurate investigations of special design problems and authoritative review and

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626. Propeller Project Engineer—Immediate permanent opening for project engineer with design experience in controllable-pitch propellers from 65 to 200 hp. Good testing facilities available and excellent opportunity for advancement with established Mid-West manufacturer. Reply stating full particulars of past experience, salary required, and other useful information.

616. Associate or Full Professor—A leading Midwestern university which is developing an extensive graduate instruction and research program in the fields of high velocity aerodynamics and jet propulsion needs an additional permanent staff member. Teaching will consist of one-third to one-half of load, balance on research. Rank will be Associate or Full Professor. Salary attractive; advanced degree required plus practical experience.

AVAILABLE

712. Materials, Processes, and Standards Engineer—M.E. degree; seeks position with aircraft or metal fabricating plant in New York Metropolitan area or Long Island. Excellent record: nationally known author; prominent welding consultant; authority on materials, processes, and standards; research; design; administration; production; industrial engineering; estimating. Presently employed with one of America's foremost aircraft companies.

711. Professor of Aeronautical Engineering—B.S. in M.E.; M.S. in A.E. Five years' teaching experience as Associate Professor of Aeronautical Engineering, in well-established engineering college. Five years' varied industrial experience, including development work on guided missiles. Desires permanent position in recognized engineering college teaching airplane design and aerodynamics. Primarily interested in research and development of light planes. Available immediately.

710. Aeronautical Engineer—Married; age 30. Four years' experience in structures and static test. Experience in electronic instrumentation for testing. Six months at Wright Field as company representative for static test of large airplane. Two years' experience in structural and mechanical design for high-speed variable density wind tunnel. One year in Navy radar program. Now attending California Institute of Technology. Will obtain M.S. in Aeronautics in June. Would like industrial research or teaching and research with work toward a higher degree. Available in June.

709. Aeronautical Engineer—B.S. in Ae.E. Experience includes structural testing, drafting, and liaison on both military and commercial aircraft. Seeks position in structural testing or wind-tunnel testing. Location open.

708. Aeronautical Engineer—Financially independent, as the result of successful designs, desires new position on West Coast with sufficient authority or scope to be able to obtain results. Successful projects previously headed, both commercial and military, will be furnished as proof of ability to lead either design or research developments. Salary is of minor importance.

707. Sales Engineer—Engineer with 27 years' experience in aircraft engineering and manufacturing. Has ingenuity and engineering ability combined with sales ability. Desires sales engineering connection in Los Angeles area in any field requiring these characteristics.

705. Aeronautical Engineer—Former pilot; long and broad experience in nearly all phases of airplane design, manufacture, and operation. Lately specializing in gas turbines and hydraulics. Especially interested in development.

704. Aeronautical Engineer—Seventeen years' experience on airplanes and 2 years on helicopters as layout man, group leader on drafting, design draftsman, chief draftsman, project engineer, design engineer, and assistant chief engineer, concerning commercial and military aircraft. College education and 5 years' original experience in mechanical engineering.

703. Aeronautical and Aircraft Maintenance Engineer—B.Ae.E., N.Y.U., 1944. Two and one-half years' overhaul, maintenance, modification, and repair of single- and multiengined aircraft in both military and commercial aviation, plus previous limited association with manufacturing industry. Seeks a responsible engineering position to which adaptable in either manufacturing industry or air transport. Will consider overseas employment.

702. Engine Research Technician and Draftsman—College background; 2 years' aeronautical engineering; 29 years old; married. Nine years of technical and practical experience in aircraft-engine production and development. Thorough familiarization with engine design and development, laboratory testing and research, engineering analysis, and layout and detail drafting. Two and one-half years' experience with gas-turbine and jet propulsion engineering projects at U.S. Navy Air Test Research Center. Desires permanent position with leading engine manufacturer or experimental development unit in research, development, designing, or liaison capacity, preferably in New England or Eastern Coastal area.

701. Mechanical Engineer—Age 30; B.S. and M.S. degrees. Two and one-half years' aircraft-power-plant installation design and development. Three and one-half years' aircraft gas-turbine thermodynamic analysis involving design of turbine and compressor elements and performance evaluation. Both jet and prop-jet experience. Desires responsible position on gas-turbine or allied power-plant work having good growth possibilities. East Coast area preferred.

700. Project Engineer—Age 36. B.S. in M.E., plus some postgraduate work. Nine years' experience in production and development of electromechanical instruments. This work has included considerable time spent with laboratory, manufacturing, and inspection groups and also with customers on related engineering problems. Especially interested in cost-reduction work. A complete outline of experience and qualifications will be sent upon request.

699. Chief Inspector or Experimental Department Head—Twenty years' experience in the aircraft industry, including experimental, quality control, and production analysis. Seeks position as chief inspector or head of experimental department. Location open.

698. Engineer and Executive—Almost 30 years' experience on airplane and accessory design, airport selection and layout, and airplane operations engineering. Good organizer and manager; sound business experience; capable technical writer; wide knowledge of materials and processes.

697. Aircraft Structural Engineer—Graduate engineer, B.S. in M.E., Ae.E. Two years' aircraft structural design and research experience. Design experience gathered with both military and personal aircraft. Thoroughly familiar with C.A.A. requirements and static testing. Structural research experience gathered while in the Army Air Forces. Desires position in structural design or structural research department. Will locate anywhere.

696. Aeronautical Engineer—B.S. in Ae.E., New York University (Guggenheim School of Aeronautics). Almost 2 years' mechanical training and experience in the A.A.F. Six months' experience with small West Coast aircraft company performing design and stress analysis of major components of prototype airplane under supervision of chief engineer. At present, graduate student at M.I.T., specializing in rotary wing aircraft working toward S.M. in Ae.E. Good grades throughout schooling. Desires position with progressive helicopter company. Available about July 1. Details and references upon request.

695. Administrative Engineer—Age 40; 6 years in aircraft engineering department, from design engineer to managing the department of approximately 2,000 people. Past year personnel manager of newly organized aircraft maintenance base. Previous experience as an instructor in aeronautical subjects and draftsman. Desires permanent position, preferably in aircraft, involving engineering and personnel administration. Location open.

694. Management—Age 43, married, A.B. degree and B.S. in Aeronautical Engineering, plus legal training and experience. Author of seven outstanding textbooks on technical subjects. Biography in *Who's Who in America*. Member I.A.S. and Associate Member American Institute of Electrical Engineers. Last 6 years spent organizing and managing aeronautical training for engineers, pilots, and mechanics in advanced types of aircraft. Desires permanent position as organizer and manager of a well-financed college or school wishing to develop strong courses in aviation business administration, jet and gas turbine propulsion, or electronics. Prefers West Coast.

693. Development Engineer—Graduate engineer, with 8 years' experience in hydraulics, landing gear and mechanical design, seeks position with small company where the opportunity exists to expand along with the company.

692. Mechanical Engineer—Graduate; age 30; 4½ of 6 years' experience in development of mechanical components of helicopter aircraft. Interested in development work. Location: (1) New York; (2) San Francisco; (3) Seattle.

691. Aeronautical Engineer—B.Ae.E., 1942. Age 25, married. Two years' experience in design evaluation of regular and experimental aircraft. Two years' experience in aircraft flight testing and aircraft maintenance. One year's experience in supersonic research leading to the design of guided missiles. At present engaged as a research technician in supersonics. Desires administrative position as a project engineer in the research and development of supersonic aircraft. Familiar with Government contracts and procedures.

690. Administrator-Industrial Management Engineer—Representative completing 6 years in Naval Aviation as administrator of fixed price and cost-plus fixed fee airplane contracts from inception to fly-away at several large plants and the Bureau of Aeronautics. Ten years' civilian aircraft experience covering production, engineering, and quality control. Good engineering training secured at recognized technical institute and university.

689. Engineer—Five and one-half years' experience as layout draftsman on aircraft construction; location in Eastern States preferred.

688. Engineer—B.A.E., N.Y.U., major in air transport and meteorology. Two years' experience leading aircraft instrument and accessory manufacturer as designer, junior administrative engineer. Served in U.S. Navy as officer engineer in design and development of autopilots and radio-controlled aircraft and structural test models; 1 year's experience in this field including considerable flight-test work. Six months' experience with Navy as production control officer in aircraft plant. Desires work in East Coast area in any of the above fields.

687. Professor or Aeronautical Engineer—Ph.D. in Mathematics and Physics. Author of a number of published articles in aerodynamics and mathematics. Ten years' teaching experience in graduate and undergraduate engineering mathematics; over 7 years' general aircraft engineering experience, including positions as project aerodynamicist and engineering specialist on Navy and Army aircraft and guided missiles. Available for responsible position immediately either with aeronautical college or with aircraft industry.

686. Sales Engineer and Aeronautical Marketing Consultant—Exceptional aeronautical background and history. Entree to every phase of aircraft manufacture and operation. Internationally known and respected. Has excellent contacts, particularly on the Pacific Coast. Has designed and patented several successful accessories. Has been in the aircraft field for over 30 years.

685. Aeronautical Engineer—B.Ae.E., Rensselaer Polytechnic Institute with honors, full member Sigma Xi, Tau Beta Pi; now completing master's work at M.I.T. with major in vibrations and stress analysis. Energetic, intelligent, and learns quickly. Has ability to assume and desires responsibility. Desires employment in vibration research or flight-test analysis with concern on East Coast or opportunity to develop courses in vibrations at small engineering college. Plans to extend education in law and engineering administration. Résumé on request.

684. Teacher—College teacher desires position teaching aeronautical engineering at recognized college or university. Possesses B.A.E. degree, magna cum laude. Doing graduate work at present on parttime basis. Three years of progressively responsible industrial experience including analysis and design of tubular and stressed-skin structures and of the mechanical elements of civilian and military aircraft, particularly in the rotary wing field. Also some experience in theoretical aerodynamics. Over 1 year's experience as instructor of mechanical engineering at accredited college. Qualified to teach courses in aerodynamics, fluid mechanics, advanced strength of materials, airplane design, structures and stress analysis, and rotary wing aircraft.

683. Air Cargo Transport Engineer and Administrator—Available on short notice, internationally known air transportation engineer, specializing in air cargo. Just completed setting up largest all-cargo operation in Western hemisphere, in South America. Capable of making complete survey, procuring equipment and personnel, and setting up operating organization. Would be interested in acting as consultant for major railroad anticipating aircraft activity or any other organization interested in air cargo. Thirty years' experience in the aircraft operating field. Has lived and operated in Europe and South America.

682. Aeronautical or Administrative Engineer—Age 33, married. Ten years' aircraft engineering experience, including drafting of specifications, structural design, aerodynamics, and 3 years' service in the Engineering Division at Wright Field as an A.A.F. officer. Familiar with current A.A.F., Bureau of Aeronautics, British, and C.A.A. structural and design requirements. Desires position about June 1.

681. Physicist-Mathematician—Age 35. B.S. in E.E., M.A. in Mathematical Physics, B.Sc. (Oxon.) in Astrophysics. Presently Associate Professor Aerological Engineering. Four years' experience scientific book publishing (McGraw-Hill). Five and one-half years' Navy. Desires position Northeastern United States in research and/or teaching with growing responsibilities in administration.

680. Aeronautical Engineer—B.S. degree in Aeronautical Engineering, Aeronautical University, Chicago. Five years' experience in design and research with leading aircraft manufacturer, including work in stress analysis, aerodynamics, and jet propulsion. Holds private pilot's license and has had some aircraft mechanic experience. Prefers Southern California.

678. Aeronautical Engineer—With administrative experience desires position as personal assistant to executive in air line, aircraft manufacturing or related activity who should be relieved of concern over details—correspondence, reports, speeches, department liaison. Aero engineering degree, Harvard Business School. Six years' over-ocean air-line experience in maintenance and engineering, in which presently employed. Ex-Naval officer, free to travel. Has smattering of Spanish. Age 29. Interview desired.

677. Aeronautical Engineer—Technical degree received from well-known and approved cooperative engineering college of a midwestern university. Three and one-quarter years' complete stress analysis experience with leading personal plane manufacturer. Some liaison and service engineering experience. Desires position with personal plane or helicopter manufacturer or consulting engineer as a structures, service, or liaison engineer. Will consider position as aerodynamicist or sales engineer of a reliable company with a temporary salary sacrifice if well-rounded experience will be gained. Complete information will be given on request.

676. Aeronautical Engineer—B.Ae.E. More than 5 years' experience in experimental aerodynamics and flight testing. Present position is that of project engineer on high-speed developments. Desires position in Northern New Jersey or New York City which involves work in aerodynamics, design, flight testing, or wind-tunnel testing.

675. Technical Translator—Graduate mechanical and aeronautical engineer, German born, U.S.-educated, thoroughly bilingually familiar with engineering terminology, will translate German technical documents on a contract basis.

674. Aeronautical Engineer—Aerodynamicist, B.Ae.E., age 22, single. Has over 2 years' experience in wind tunnel work, air loads, performance, stability, and control. Will receive M.Ae.E. during present school year. Good background in theoretical aerodynamics, stress analysis, and jet propulsion. Interested in teaching. Must remain in New York City vicinity until July 1. Available immediately.

673. Teacher—Graduate of the Massachusetts Institute of Technology in aeronautical engineering desires a teaching or administrative position with a foreign or domestic college or university. Qualified to teach aerodynamics, airplane design, wind-tunnel techniques, modern flight-testing methods, air-transport problems, and related fundamental subjects. Holds C.A.A. single- and multiengined commercial pilot's license, with instrument and instructor ratings. Prefers position with opportunity for combining academic work with flight testing, flight demonstration, and/or flight instruction. Has had administrative, practical, and teaching experience in the aviation field. Will gladly furnish complete credentials, with references, upon request.

669. Aerodynamics Engineer—Chief aerodynamics engineer with prominent aircraft company. Advanced degree in mathematics and physics. Publications in dynamics and thermodynamics. Experience in aircraft heating and deicing. Desires position in metropolitan area with progressive concern or recognized university.

668. Administrative or Executive Engineer—Twenty years' well-rounded experience in all phases of organization, systematizing, design, engineering, production, and helicopter. Has experience in the automotive, aircraft-engine, and aircraft industries. Formerly experimental engineer, assistant engineer, factory manager, and general manager. Will definitely consider position in other than aircraft industry.

667. Aeronautical Engineer—B.S. Degree in Mechanical and Aeronautical Engineering. Taking graduate studies majoring in aeronautics. Two years' experience in drafting and aerodynamics in the aircraft industry, doing layout, major detailing, casting and forging drawing. Interested in aerodynamics or stress-analysis positions. Will accept mechanical or aeronautical engineering position in the Far East, especially in the Philippines.

666. Sales and Service Engineer—B.Ae., N.Y.U., 1941; married, age 28. Four and one-half years' A.A.F. Engineering Officer (Major). Varied technical and administrative assignments in connection with modification, overhaul, and repair of all types of aircraft and associated equipment. One year own manufacturing business. Few months air line. Completing training for Commercial Pilot Certificate. Particularly interested in sales and service or employment with overhaul and/or modification agency.

665. Training Supervisor—Twelve years of practical aeronautical and teaching experience, ranging from instructor to training supervisor at a U.S. Naval aircraft shore establishment. Background includes the training fields of private trade school, public school, air line, and Government plants. Capable of planning, administering, coordinating, teaching, and testing school, shop, and supervisory improvement courses. Experience has covered mechanical training on the job, apprenticeship training, supervisory improvement training and testing, and veterans' training.

664. Aeronautical Engineer—B.Ae.E., age 29, married, veteran of World War II. Four years as a Naval Aviator. Two thousand hours' flight experience in single- and multiengined land and sea aircraft. Possesses valid commercial pilot's license. Experience as a project engineer, design draftsman, and stress analyst. Working knowledge of all phases of aviation. Desires position as a flight test engineer. Will consider positions anywhere in the continental limits of the United States.

663. Engineer—Heating, ventilating, and exhaust systems engineer; B.S. in Ae.E. Age 29, married. Four and one-half years' experience in the design, maintenance, and overhaul of aircraft exhaust, heating, and ventilating systems. Completely familiar with all types of aircraft and ground heaters, heat exchangers, anti-icing and deicing systems and ventilating systems. Experienced in problems relating to aircraft-engine exhaust systems, such as collector rings, short stacks, flame dampeners, silencers, and carburetor heater shrouds. Has a working knowledge of turbosupercharger and induction systems. Exceptional executive and supervisory experience. Desires position as sales or field service engineer. Other engineering positions will be considered.

662. Production or Factory Management—B.S.E. (Aero. Eng.); top quarter, Big Ten University class. Six months' prewar experience in production control with leading parts manufacturer. Three years as A.A.F. engineering officer in charge of aircraft overhaul subdepot, supervising 350 civilian employees, machine shop, sheet metal, welding, woodmill, etc. One year postwar as aircraft structures engineer. Desires responsible position in production or factory management with progressive-minded manufacturer of mechanical products. Keenly interested in production control, production planning, and factory management and will consider opportunities in any related position. Mid-West preferred.

661. Research Engineer—Age 29. B.S. in M.E., University of Pennsylvania, 1940. Experienced analyst in thermodynamics, heat transfer, general fluid mechanics, and aerodynamics. Present employer well satisfied, but applicant wants nonmilitary research work. Six and one-half years with large aircraft manufacturer, past year and one-half on supersonic studies, including setting up Schlieren optical system and developing method of analysis for flow of compressible fluids.

660. Engineer-Pilot—M.E.; several years' experience many military and commercial types, land, sea, and helicopter; commercial and instrument ratings; 4 years' test and research with reputable organizations. Good knowledge of operational problems; well acquainted with current electronics equipment and its limitations. Desires change. Interested in pilot-engineering-administrative position with concern having well-backed program.

659. Aeronautical Engineer—B.S.A.E., age 30. Eight years' aircraft engineering, design, and fabrication experience including 2 years of stress analysis and testing; 2 years of production engineering and liaison work; 4 years as design group leader on surfaces, controls, and power plant installation; assistant project engineer. Present

position design engineer, general. Familiar with Army, Navy, and C.A.A. requirements. Some experience on guided missiles. Presently taking evening graduate work in mathematics and engineering. Interested in design work. Available on 30 days notice. Location open.

658. **Administrative-Executive-Field Service**—Desires to join group with sound research and modest production program. Twenty-one years' experience in the industry in almost every phase; now staff member in responsible position with large engine firm. Holds commercial pilot's license with instrument and instructor ratings, single- and multiengined, A and E license. Prefers to affiliate with group that can use several thousand hours' flying experience plus sales and executive ability.

656. **Management Executive**—B.S. in M.E. Over 20 years' experience in aviation, including engineering, production, quality control, materials, contracts, labor problems, costs, contract termination, and property disposal. Five years' research, N.A.C.A., hydrodynamics, and aerodynamics. One year on flight performance data analysis. A and E mechanic, private pilot. During war represented the Bureau of Aeronautics in plants of major aircraft manufacturers, heading staffs up to 160 engineering, clerical, and shop personnel. Long experience in dealing with Government agencies. Desires responsible position with an organization needing a versatile, well-informed executive.

655. **Engineer or Executive**—Twenty-four years' experience in tool, production, and design engineering; 8 years in aircraft. Positions filled include project engineer, chief tool designer, chief production engineer, and chief engineer. Thoroughly capable of handling either design, production, or tooling and methods. Willing to accept lesser position if opportunity for advancement is evident.

654. **Administrator-Engineer**—Twenty years in aviation engine and airplane manufacturing, including 3 years as project officer on transport aircraft design in Bureau of Aeronautics. Experience includes positions in engineering, financial, and administrative divisions. Capable, versatile, dependable. Desires connection as military liaison, manufacturer's representative, or executive assistant in New York area.

645. **Associate Professor of Aeronautical Engineering**—Doctor of Aeronautical Engineering in a large Mid-Western university would like to change his position for a similar one. At the present time gives structural courses. Possesses experience in wind-tunnel operation and a thorough knowledge of aerodynamics.

641. **Aeronautical Engineer**—B.Ae.E., Rensselaer Polytechnic Institute, 1939. Age 31, married. Private pilot. Eight years' design and field engineering work including administrative and supervisory experience for major aircraft accessory manufacturer. Ground and flight test experience, both Army and postwar commercial planes. One year project engineer and market analyst for development of light-plane products. Well-established West and East Coast aircraft contacts. Desires administrative or sales engineering position in aircraft or allied industry. Prefers East or West Coast. No objection to traveling. Available immediately.

618. **Meteorologist-Engineer**—Graduate meteorologist and engineer; B.S. Meteorology, New York University; B.S.M.E., Case School of Applied Science. Age 28. Served as commissioned meteorologist with A.A.F. in U.S. Served as operations and dispatch officer with A.T.C. overseas for 14 months. Three and one-half years in service. Position wanted with air line or other concern interested in air transportation. Interested primarily in flight operations or traffic promotion work. Holder F.C.C. radio permit and C.A.A. Tower Controller's Certificate. Will consider work in domestic or foreign fields.

Books

(*Continued from page 81*)

Operations by the Committee of Coordination of Scientific and Technical Societies of France. A speech by J. Demaret, expressing the committee's admiration and gratitude, followed by two speeches by General Moore.

Japan's Struggle to End the War. Washington, U.S. Strategic Bombing Survey, 1946. 36 pp., tables. Japan's political background during the war is outlined. The second part of this report deals with Japanese national resources and the comparative military strength of Japan and the United States in 1941 and 1945. Biographies of Japanese leaders are contained in the third section.

Jeeps in the Sky; the Story of the Light Plane. Andrew Ten Eyck. New York, Commonwealth Books, 1946. 151 pp., illus. $3.00. The story of the work done by light planes during the war, including observation, rescue work, transportation, and special missions. The final chapter covers postwar private flying. A useful chronology of flight and the light plane from 1898 to 1941 is included as an appendix.

Omaha Beachhead (6 June–13 June 1944). Historical Division, War Department. Washington, 1945. 167 pp., illus., maps. Narrative of the invasion of Normandy based on a documented manuscript in the War Department. Occasional mention of air action.

Summary Report (Pacific War). U.S. Strategic Bombing Survey. Washington, Govt. Printing Office, 1946. 33 pp., maps. The results of the use of air power in each of its several roles in the war in the Pacific are described, including the effects of the atomic bombs. Unique features of the Pacific war are pointed out, and the report includes recommendations for the future

GENERAL

Aviation Questions and Answers. G. D. Duguid and W. H. McMahon. London, Sir Isaac Pitman & Sons, Ltd., 1944. 101 pp., illus. 3s., 6d. A review book for pre-examination use, covering navigation, engines, instruments, propellers, etc.

European Imprints for the War Years Received in the Library of Congress and Other Federal Libraries. Part 3, French Imprints, 1940–1945. U.S. Library of Congress. Ann Arbor, Mich., J. W. Edwards, 1946. 284 pp. Reproduced from typewritten copy. Arranged alphabetically by author. Many entries have L.C. classification and card number.

Who's Who in New York (City and State), 1947. 11th edition. New York, Lewis Historical Publishing Co., 1947. 1,235 pp.

The Wright Aero Handbook. Wood-Ridge, N.J., Wright Aeronautical Corporation, 1946. 98 pp. Pocket-size compilation of frequently used data for pilots, flight engineers, and mechanics.

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